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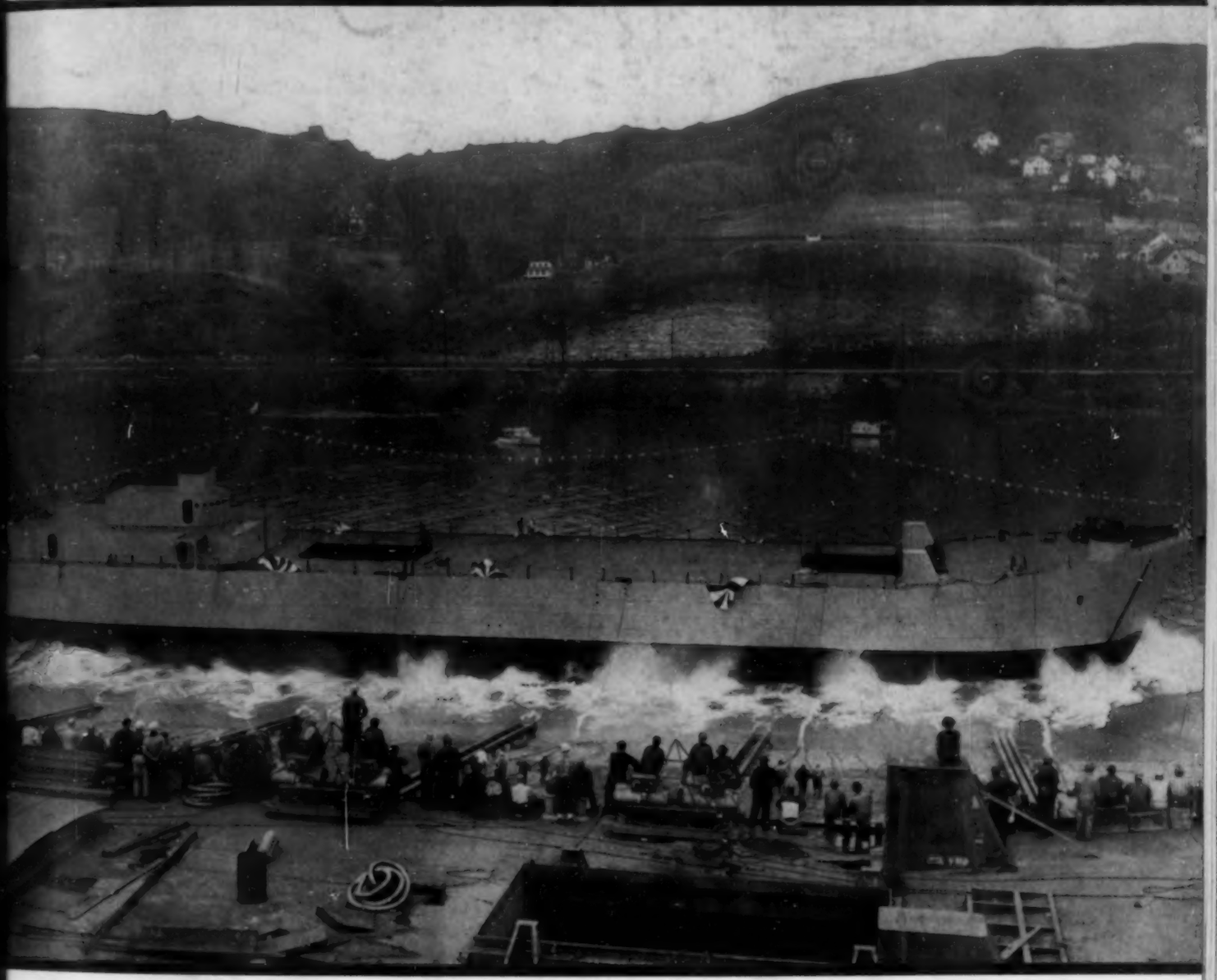
CIVIL ENGINEERING

Published by the
American Society of Civil Engineers



SIDE LAUNCHING AN ALL-WELDED BARGE AT AN INLAND YARD
Development of Modern Shipyards Incorporating Assembly-Line Methods Is Described in the Article on Page 201

Volume 13 — *Number 5*

MAY 1943

It's Your Baby

Here is one of the Army's new medium tanks. Whether you help to fight in it, make it or pay for it . . . it's your baby. All the tanks, guns, planes and ships that are built or are being built to protect your freedom are your babies. And you've got to support them with your personal courage, energy and earning power as a free citizen. The penalty for non-support may be slavery or death.

If what you are now doing with your courage, energy and earning power is not directly or indirectly helping the war effort . . . you are guilty of non-support.

Join the armed forces; engage in a war industry; enlist in civilian defense activity; invest in war bonds and stamps. Devote your freedom and your life to the cause of Democracy . . . or you may lose all three.

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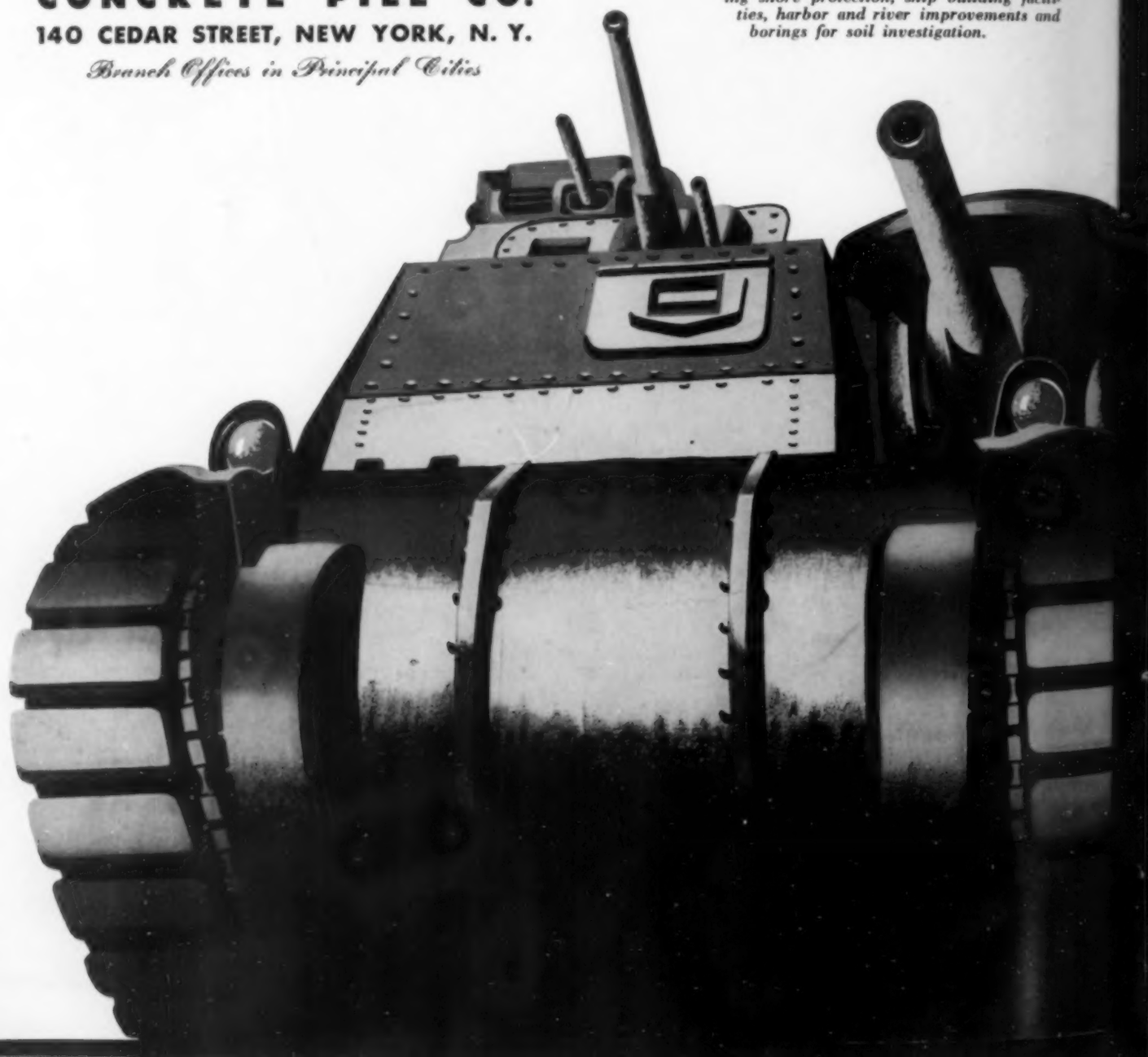
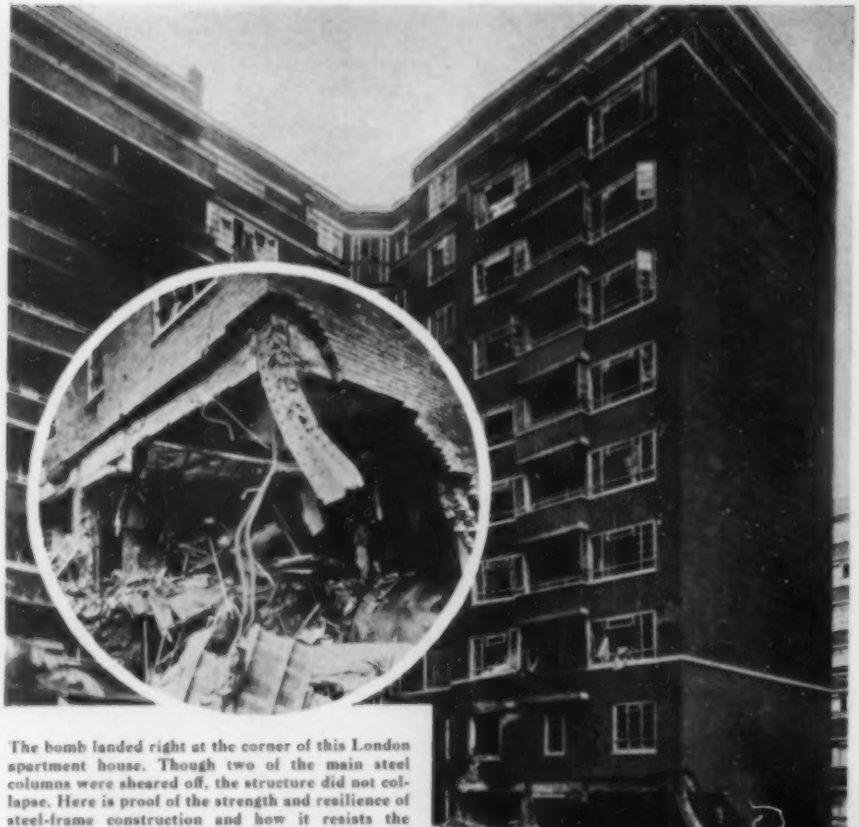


Speeding up War Production

FABRICATING a massive steel pedestal. Thousands of similar welding operations are helping to speed up production of cargo ships, warships, submarines, tanks and other munitions.

"Survival of the Fittest"...



The bomb landed right at the corner of this London apartment house. Though two of the main steel columns were sheared off, the structure did not collapse. Here is proof of the strength and resilience of steel-frame construction and how it resists the wholly unpredictable stresses resulting from bomb blasts.

* * *

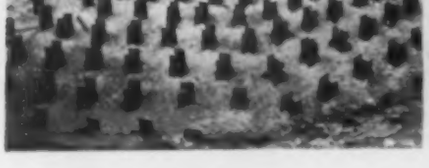
[*Middle right*]

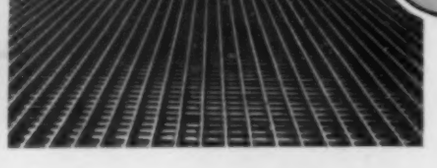
Deep roots of steel defy flash floods and scour. On this Missouri Pacific Railroad bridge, sturdy bridge piers of U·S·S Steel Sheet Piling, built in twin cylinders of 16 piles each and driven through 25 ft. of sand and gravel, provide economical, substantial foundation where washouts frequently overwhelmed former wooden trestle.

[*Lower right*]

U·S·S I-Beam-Lok on this 24 ft. roadway of the Potomac River bridge reduces floor deadload 4,545,000 lbs. Weighing only 55.5 lb. per sq. ft. it saves 720 lbs. per lineal foot as compared to ordinary reinforced concrete slabs of equivalent strength.

308 U·S·S Steel Bearing Piles, 85 ft. long, support brick chimney 370 ft. high, designed to withstand a wind velocity of 100 mph. Set radially as shown and driven in unspliced lengths to 84 ft. penetration, these piles were selected not only for their excellent bearing qualities but because their straight untapered sides provide great resistance to withdrawal.





WAR . . . the world's toughest testing laboratory has emphasized three important advantages of steel—its versatility, its high resistance to destructive forces far beyond ordinary calculation, and its ability to speed up construction needed in a hurry.

IT is hard to realize that structural steel as we know it today had its advent less than 60 years ago.

The first structural sections were rolled in our mills in 1884. Wide-flange Carnegie Beam sections (now widely known as CB's) followed some years later.

The first steel sheet piling rolled in America was produced by this Company. U·S·S I-Beam-Lok pioneered the field in lighter, stronger and longer-lasting bridge flooring and decking.

It is because no other structural material even approaches steel in its high modulus of elasticity—because steel construction offers superior strength, stiffness, durability and permanence, with economy as well—that steel has become the very basis of modern engineering construction.

For these reasons we remind you to include, in your plans for the future, the engineering steels and steel products that today are confined to essential war construction.

Then, U·S·S Steel Sheet Piling, Steel Bearing Piles, I-Beam-Lok Steel Flooring, Steel Culverts, Reinforcing Bars and other U·S·S steel engineering specialties will be fully available—improved by their wartime service—ready to serve you better than ever before.

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Something to Think About

A Series of Reflective Comments Sponsored by the Committee on Publications

Engineering Pedagogy

An Analysis of the College Professor from the Point of View of the Practicing Engineer

By JOHN M. HAYES, ASSOC. M. AM. SOC. C.E.

ASSOCIATE STRUCTURAL ENGINEER, TENNESSEE VALLEY AUTHORITY, KNOXVILLE, TENN.

MOST engineers take inventory of their professional status from time to time. In this periodic survey, the engineer tries to evaluate his present position and determine why he has or has not progressed as fast as he would have liked. He tries to analyze everything that has affected his professional success.

Looking Backward to Academic Halls.—He probably begins with his college days, which causes him to consider what contribution his engineering teachers made in the development of his engineering career. Was this contribution all that it should have been?

This naturally brings up the question: What are the qualifications for a teacher of engineering? These qualifications have probably been set forth by various members of the teaching profession. But it is usually the engineer who has had no teaching experience, who wonders how much the ability of his engineering teachers has had to do with his professional success. The following is an attempt to discuss the qualifications of a teacher of engineering from the viewpoint of the practicing engineer.

The Twofold Purpose of Education.—The fundamental purpose of any teacher is to teach. He has a definite place in the education of the individual. Now what is this place which the teacher holds? To define it, it is necessary first to define education itself. What is meant by education? What is the purpose of education? The fundamental purpose of education is the development of a human life—the development of a philosophy of life that will enable a human being to live at peace with his fellow men, and with his own inner self. The secondary purpose of education is to impart to the individual certain skills, either physical or mental, that will enable him to earn a living and to take his place in the service of his fellow men. The purely technical side of engineering education comes under this second heading.

As for the purpose of this technical education of the engineer, it is to impart to him a knowledge of the laws governing the acts of nature and of how best they can be directed to serve mankind. The accumulation of this knowledge is only a means to an end—this fact must never be forgotten.

With these fundamental definitions in mind, the qualifications for a teacher of engineering can be determined. The following qualifications are not necessarily discussed in order of their importance. All are required for a well-balanced teacher.

Theoretical Background.—The first qualification for any teacher is a good working knowledge of the subject to be taught. This is very important for the teacher of engineering. Here technical accuracy is of the utmost importance. Therefore he must be well grounded in the fundamental sciences of engineering.

This does not mean, however, that he should be a theoretical bookworm. The competent teacher of engineering never becomes so engrossed in the intricacies of academic precision that he loses sight of his fundamental goals—the development of a human life and the imparting of knowledge on the physical laws which govern the forces of nature.

A capable research professor does not necessarily make a good teacher—research demands different talents from those needed for teaching. It is not always the best student who makes the best teacher. Many engineers can recall from among their teachers brilliant men who were a failure in the classroom and in giving counsel to students.

Practical Experience, a Matter of Great Importance.—To the teacher of engineering, practical experience in the subject to be taught is of the utmost importance. He should have had enough such experience to make him intimately acquainted with the practical aspects of engineering—this cannot be learned from books. For a teacher of engineering to pass on knowledge to be used by an engineer "on the job," he must know exactly the mental attitude of the man in actual practice. Only several years of experience can give a true picture of

engineering science at work. This experience cannot be gained by a few months of summer work.

The lack of a sufficient amount of practical experience is a weakness of many teachers of engineering. Every teacher should be able to help the student understand what to expect after graduation. The large number of disillusioned engineering graduates on their first job is testimony to the fact that their theoretical training did not acquaint them with what to expect in practice. Perhaps if all teachers of engineering had to have a certain minimum amount of practical experience, this condition could be remedied.

Preparation for the Teaching Profession.—The accepted way, at least in a large number of instances, to become a teacher of engineering seems to be to become a graduate assistant upon receiving the bachelor's degree, and to continue teaching after obtaining the master's and possibly the doctor's degree. There may or may not be actual engineering experience during vacations.

This is a poor substitute for a prolonged period of practical experience, especially in obtaining an understanding of the viewpoint of the engineer on construction work. This observation is not meant to belittle graduate work. It is of importance too, but it is not enough in itself.

Too Much Emphasis on the Academic.—In too many cases, more importance seems to be placed upon the completion of certain formal academic courses, such as those for a doctorate, than upon the development of a practical knowledge of engineering. Both are important. The successful engineer in actual practice has increased his theoretical knowledge either formally or by self study, depending upon individual circumstances. It is to be regretted that more successful practicing engineers, who profess an interest in teaching, cannot be drawn into the teaching profession. The financial viewpoint is one disadvantage.

Every engineer can readily recall from his own college experience the difference that a few years of practical engineering work can make in a teacher of engineering. Many engineers seem to think that no one should be allowed to teach engineering until he has had a minimum of about seven or eight years of actual progressive engineering experience. An engineer who is a failure "on the job" cannot be a success in the classroom.

Genuine Interest in People and Teaching.—Every man must be interested in his work if he is to become a success at it. The teacher of engineering must be interested in the diffusion of knowledge—not for the sake of the knowledge itself, but because of what that knowledge, in adequately trained hands, can do for the welfare of mankind. He must have a genuine interest in the welfare of the individual student—not only in developing his engineering knowledge but in developing him as a worth-while human being.

He should not take up teaching because it is the path of least resistance. Along with an interest in people must go an understanding of the processes of learning. The teacher must know how to help the student assimilate engineering knowledge. He must understand the viewpoint of the student and have patience with him in his seeming slowness to grasp subject matter which, although familiar to the teacher, is new to the student.

Well Balanced, Mature Individual.—The teacher must command the respect of the student. To command respect he must be of good moral character and have an even temper. A teacher must, indeed, be a man of great patience. He must be as near an average individual as possible. A teacher, of all people, needs to live a well-balanced life. The jokes about the "absent-minded professor" carry a large amount of truth in many instances. But a teacher definitely should not be a freak.

A good teacher must be able to give competent and friendly counsel to the student. This means that he must have the respect of the student. It also means that he should be mature enough to have an adequate understanding of the problems of life. The development of a human life demands the utmost in patience and skill.

The teacher of engineering should have fair ability in public speaking. There is no surer way to lose the respect of students than to have slovenly habits of speech. Students' memories of many lectures are of the nervous mannerisms of the speaker, not of the subject matter. The teacher should be the same both inside and outside the classroom. Many teachers lose their effectiveness and influence by assuming a pedagogic attitude when they are in the classroom.

Inculcating a Feeling of Professional Pride.—For the successful growth of the engineering profession, every engineer must have a genuine feeling of professional pride. He must consider himself obligated to do everything in his power to further the development of the profession to which he belongs. A feeling of professional pride must be inculcated in the engineering student at the earliest possible moment. There is no better way for the student to cultivate this feeling than by coming into contact with teachers who have it themselves.

Every young engineering graduate needs faith in his profession to carry him over the first few "rocky" years of actual contact with engineering practice. The logical place for him to get this faith is from the teacher of engineering. Therefore it is imperative that the teacher have a real interest in his profession and an intimate understanding of the conditions that the student will meet with when he leaves academic halls.

Idealistic—But Practical.—Some may call this point of view idealistic, but after all what is life but a conglomeration of ideals? It is just as easy to cultivate the right ones as the wrong ones, especially if one has a little understanding guidance.

The qualifications that have been outlined—theoretical knowledge, practical experience, human understanding, maturity and balance as an individual, and pride in the profession—constitute the minimum for a good teacher of engineering. At least, from the point of view of the practicing engineer, looking backward to determine what he needed most from his teachers, these attributes seem essential. They are probably different from those set forth by many who have the final vote in the appointment of such teachers. But the engineer knows the kind of training he has felt the greatest need for in his professional career. He has a right to demand for those that follow him the quality and content of education that he deems essential to meet these actual needs.

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VOLUME 13 NUMBER 5

Mass Production Methods in Shipyards

Extensive Welding of Pre-Assemblies Used in New Yards

By ADOLPH J. ACKERMAN, M. AM. SOC. C.E.
DIRECTOR OF ENGINEERING (AND PLANT EXPANSION), DRAVO CORPORATION, PITTSBURGH, PA.

FROM its peacetime objective of "the most ships for the least money," to its wartime objective of "the most ships in the least time," the shipbuilding industry switched overnight with the entrance of the United States into the war. Ships now slide down the ways at a rate that is a challenge to the suppliers of christening champagne. From his close association with the shipbuilding industry, Mr. Ackerman draws this account of the development of its mass production methods. Articles in subsequent issues will deal with other aspects of inland shipbuilding.

BY removing the limitations of money and economics and substituting the one objective of "production," the war caused the shipbuilding industry to abandon the methods of "custom-built construction," and to adopt those of the assembly line. These latter methods not only increase production speed but also lower the cost per ship and give better utilization of manpower.

The automotive industry went through this transition as a logical development under highly competitive conditions, when the public demand for cars justified the investment in assembly-line plants for mass production. The airplane industry would have gone through it at some future date, without the benefit of subsidized plants, if the war had not come when it did. The same thing is true in some degree of the shipbuilding industry, where the largest and most expensive units of transportation are produced. As will be indicated, the principle of the assembly line in shipbuilding had already been adopted to some extent as early as 1936, before the present war program began, as a result of competitive economics.

PRESENT-DAY SHIPYARDS

The present shipbuilding program is in general being carried out by responsible organizations which may be classified in four general groups:

1. Large and established shipyards with a long record of experience.
2. Small yards with a good record of experience which qualified them for large contracts and the necessary enlargement of their plant.
3. Organizations from other industries with proved administrative ability which hired shipbuilding experience to assist in operating newly constructed yards.
4. Established Navy Yards.

As for the first group, existing large yards, these were in general well equipped for peacetime operations, with a good quality of management, skilled labor, and well-tried practices and traditions. In each yard, the plant is in general a fixed unit. As such it defines the tempo of shipbuilding and, in the processes of development, it tends to perpetuate some of the older methods; this tendency also carries through into new expansions. Methods and skills of past years are retained as representative of the productive ability of the workmen, and the management is influenced to do some of its planning for the future in terms of such limitations. Workmanship in such plants has usually been of high quality, and the work was done in terms of quality and economy, with time secondary. Where the war program has brought about expansion in such yards, every effort has been made to utilize the maximum of modern methods in terms of speed, but in many cases only within the limits of their established procedures.

The second type of shipyard, relatively small in size but with competent management and good experience, has grown up in the building of smaller types of vessels. This field is more competitive and there are more units to build. Because of the smaller size of the plant and the moderate investment, such a yard is more easily

A SHOP-WELDED PRE-ASSEMBLY
Introduction of Such Pre-Assemblies in 1936 Caused Shipways to Be Reserved for Final Assembly Only

adapted to improvements and changes in methods to raise the efficiency and economy of operation. These in turn generate further improvements. Such yards had the opportunity to work out, on a relatively small scale and in terms of economics, most of the processes of welded pre-assemblies, production lines, and mass production which were later adopted on a large scale when the war began. This paper will deal more specifically with this type of yard.

The third group of shipbuilders, the so-called "newcomers," started out with brand new plants in which they had the opportunity to incorporate all the most modern developments of the industry, without the restrictions of old-time plant, and with advance knowledge that they would have a sufficient number of ships to build to justify the immediate adoption of mass-production plant and methods. The majority of these yards were organized either as subsidiaries of the large established yards, or by the conversion of enterprising organizations from the construction industry and others.

Large public works construction programs of the past decade have developed a number of competent construction organizations with the vision to build in a large way, and with the courage to undertake any type of new project with self-assurance. Such organizations have been trained to deal with a great variety of day-to-day problems, and this compensates for their initial lack of experience in the specific routines of established shipyards and shops. In taking the initial steps in any new project, they have been trained to build their plants sufficiently large to do the job and to accommodate all the manpower needed; they have learned to plan in terms of movement of materials and management of labor.

BASIS OF MASS PRODUCTION IN SHIPBUILDING

Modern mass-production methods in shipbuilding are based on the following fundamental factors:

1. Widespread adoption of the new techniques of welding in place of riveting.
2. New principles of ship design in terms of welded joints and large pre-assemblies.
3. A large demand for ships, which justifies investment in plants designed for mass-production methods.
4. Development of special shipyard cranes of large capacity for placing heavy pre-assemblies in any part of the ship.

The first of these factors, the introduction of welding, has eliminated the necessity for erecting each element of a hull in its place with pre-bolting to match rivet holes. Welding introduced freedom in the layout of joints for fit and in the arrangement of structural members to carry stresses. Early failures on small weldments, due to shrinkage cracks or warping from differential heating and cooling, led to annealing and stress relieving. That this was not feasible on large ship pre-assemblies in some respects accounts for the slower introduction of welding on large hulls. Careful study and development in the sequence and technique of tack welding and final welding

TYPICAL BARGE PRE-ASSEMBLY, ALL WELDED IN FABRICATING SHOP

have made it possible to control the distribution of heat and the tendency towards distortion in a satisfactory manner. Thus it is not necessary to anneal large ship pre-assemblies, even though they may contain substantial locked-in stresses.

Secondly, the Naval Architect abandoned the tradition of giving each ship its own personality, and instead planned his design work, and utilization of materials and equipment, in terms of hundreds of ships from the same pattern. The Production Engineer was brought into the Naval Architect's Office to dictate details of design and construction to suit mass-production methods. The new process of design calls for breaking down a ship into box sections or pre-assemblies, usually weighing between 10 and 30 tons, but sometimes up to 60 and 80 tons, or even more. The location of joints in the hull plating is carefully established so that each pre-assembly is a self-contained structure, suitably proportioned for convenient fabrication and placing in the ship. The sequence of introducing and joining together the various pre-assemblies must be carefully established in advance. This sequence must take into account the structural requirements of the hull, the overall alinement, and the adjustment of closure joints. The outlines of each pre-assembly must be carefully defined so that each succeeding pre-assembly will fit accurately along the entering plate edges, with respect to mating stringers, stiffeners, and bulkhead elements, without interferences, at the same time permitting joining of the members by welding into an integral unit.

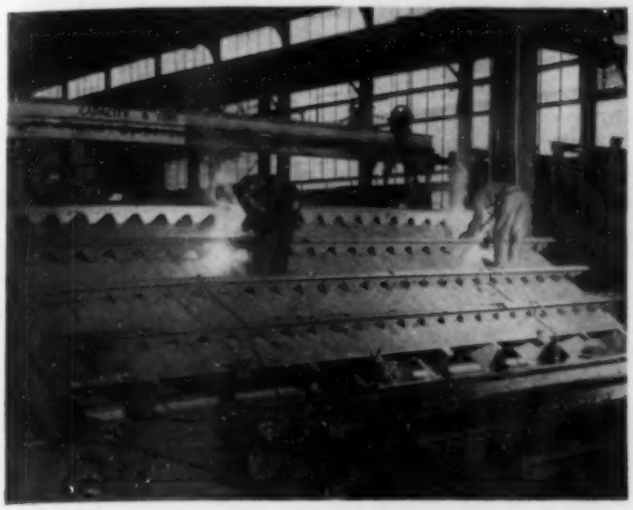
The third fundamental for mass production is a sufficient demand for ships to permit the economic adoption of production-line methods. On this basis the greater investments in new types of shipyards are justified. These new yards differ considerably in layout from most pre-war types.

ORIGIN OF THE ASSEMBLY LINE IN SHIPBUILDING

When the sudden unlimited demand for ships was created by the present war, most of the problems of welding and prefabrication for the mass production of ships had, fortunately, already been solved. This was accomplished during the past decade as a result of meeting the growing demand for towboats and barges on the

BARGE BEING BUILT UP ON SIDE LAUNCHING WAYS
Typical Old-Style Method of Riveting Hull Together Piece by Piece

inland waterways. Since 1928, Dravo Corporation, located on an inland river, a relatively small company compared with modern shipyards, had been meeting this demand by building more than 100 hulls a year. This



TILTING TABLE DEVELOPED TO MAKE WELDS "DOWN-HANDED"

means a launching every three days. These hulls, which average 175 ft to 200 ft in length, are not in the same class as ocean-going ships but are of sufficient size to involve fabrication and erection problems similar to those encountered in the large shipyards.

Ten years ago, inland river barges were still of all-riveted construction. In 1931, this company experimented with welded hulls and by 1936 had developed its methods sufficiently to abandon riveting entirely. During that year, the use of pre-assemblies had reached the point where it was a matter of erection economy to assemble several barges side by side and, upon completion, shift them sidewise to the launching position. This was the beginning of the assembly line at that plant.

It is significant that as recently as 1937 this yard had the highest production, in terms of total gross tonnage launched during the year, of any shipyard in the country. During that year, of course, shipbuilding in the larger coastal yards was at a low ebb. However this production record shows that in some respects this yard served as a pilot plant for modern production-line methods in shipbuilding.

It is furthermore significant that this yard went through the process of conversion to mass production methods, development of multiple fabrication, extensive use of pre-assemblies, and development of the necessary design technique for all-welded hulls, under highly competitive conditions. Thus each development has stood the test of economics while contributing to greater speed of production.

SIDE LAUNCHING

All launchings are sidewise because of the high river bank and the desirability of maintaining the assembly berths above ordinary high water. Sidewise launching permits assembly on an even keel with access to the full length of the hull, and provides for maximum utilization of launching ways. During launching the hull is not subjected to stresses in excess of those experienced in the water under normal operation. Furthermore, such launching ways do not require cofferdams for their construction. A great variety of barges, towboats, floating cranes, dredges, and similar craft had been launched by the side method, so that there was no question but that this method could be extended to considerably larger ships.

In 1937 the principle of the assembly line for barge construction had established itself to the point where it was decided to construct a large shop with overhead cranes to permit assembly under cover, independent of the weather. By this method, both cost and assembly time were substantially reduced. In the process of assembly in this shop, a system of transfer tracks was utilized to move the barges first sidewise in two stages; then, on completion, endwise out of the building; sidewise again to the painting position; and on to the launching position.

The heart of the transfer system is a group of transfer carriages, each consisting of a steel frame with four wheels cut from solid billets, operating on roller bearings and carrying four 30-ton hydraulic jacks which are operated from a single pump. Each carriage is thus capable of transporting a load of 120 tons. The carriages run on a special track system, and provisions are made at transfer points for temporarily lowering a barge onto permanent blocking. The carriages can then be swung around 90°, so that when they have again picked up the barge, they can travel at right angles to their former direction. Movement of the entire system is accomplished by means of a 20-hp stationary winch connected by cable to the barge.

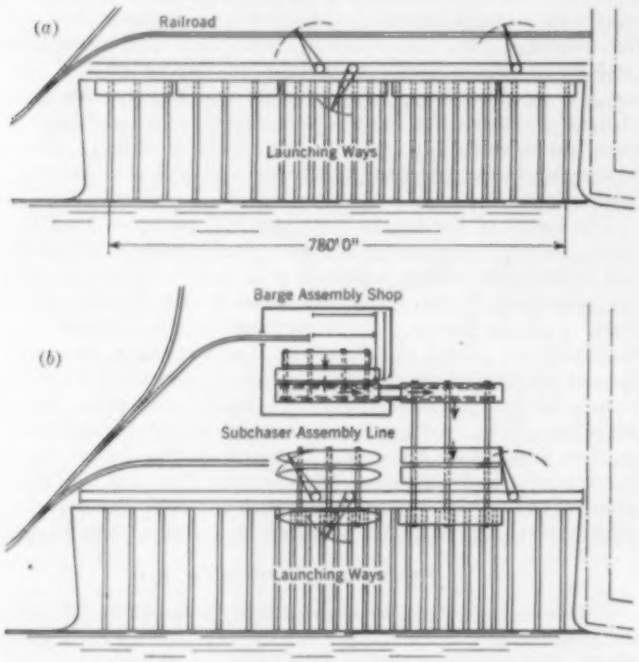
USE OF PRE-ASSEMBLIES

The key to successful mass production lies in the efficient use of pre-assemblies. Within the prevailing limitations of existing shops, fabrication of structural steel members was rearranged to conform as fully as possible with the newly adopted welding methods. Special jigs were constructed to hold the component members during the preliminary tack welding. Pre-assemblies are then transferred to tilting tables for final welding. Such tables provide means for periodically tilting the pre-assembly so that up to 80 or 90% of all the welding can be done down-hand. A maximum of down-hand welding is advisable because this shortens the total welding time by 25 to 40%, lessens fatigue, and also reduces the training time for welders. In Navy tests made in our shop, four down-hand welders were able to qualify for every one overhead welder. Thus it is possible to use men and women of average qualifications, to simplify the problem of labor supply and turnover, and at the same time to secure welds of better quality. It did not take long to demonstrate that mass production methods would cut the cost of barges at least 10%, and systematize operations so as to provide a better utilization of labor.

From 1937 to 1940, the company utilized pre-assemblies to expand activities on its shipways at an Eastern tidewater site, where barges were assembled for service in the New York and other East Coast harbors. The use of pre-assemblies proved so effective that a method was

EARLY WELDED BARGES WERE ASSEMBLED IN MUCH THE SAME MANNER AS THE RIVETED ONES HAD BEEN

developed for building them in the Pittsburgh district and shipping them to the Eastern yard for final assembly, so as to meet competitive conditions on the East Coast. Because of this procedure, there was no occasion to establish fabricating facilities in the Eastern yard until 1942, following the outbreak of war.



DIAGRAMMATIC COMPARISON OF OLD AND NEW METHODS OF BUILDING BARGES

(a) Early Erection Directly on the Launching Ways
(b) Procedure of Shifting Hulls Through Assembly to Final Position on Launching Ways.

During 1938 and 1939, the welding of heavier plates for larger ships was being adopted in the larger shipyards along the East Coast and the Gulf, and in 1940 the first all-welded tanker was launched. However, a complete change-over to welding procedure had not at that time taken place in the large shipyards because of established methods and limitations in existing plants.

When the war made it necessary suddenly to increase the shipbuilding facilities throughout the United States, a great number of new yards were built. Most of these yards were designed in accordance with fundamental principles of mass production and prefabrication. Certain types of ships are still being built by more or less conventional methods, that is, by performing most of the operations directly on the ways. This is true particularly of the older yards, but even in them pre-assemblies have been introduced wherever feasible within the design requirements of the ships.

As an indication of the type of planning and data used in laying out a modern shipyard for the mass production of 10,000-ton freighters, Table I may be of interest.

A COMPARISON OF PRODUCTION RECORDS

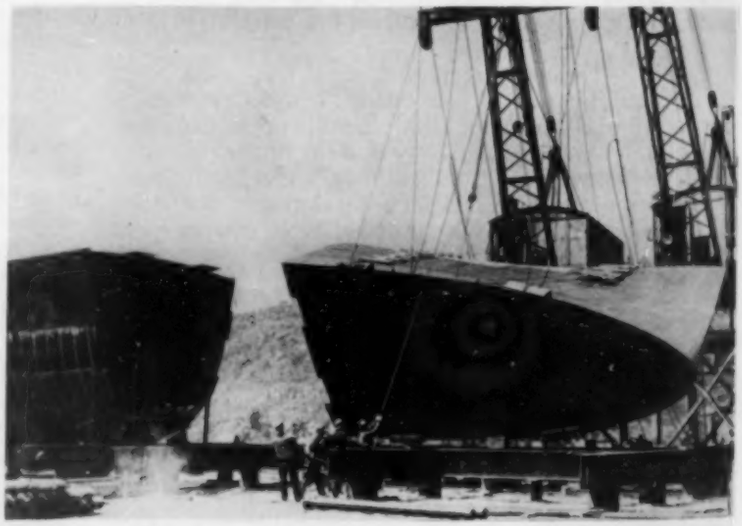
A more dependable basis for comparing production records would be in terms of the number of ships completed per month, gross and net tonnage of such ships, and average man-hours per ship. However, it is not intended to detract from the impressiveness of such records as 14 days, 10 days, or 8 days from keel-laying to launching, which help to symbolize to the general public (and we hope to our enemies also) the remarkable achievements of those engaged in shipbuilding.

With the pre-assembly method, the shipways or launching ways come closer to performing the function which their name indicates, that is, transferring the ship to the water. Ordinary concepts as to keel-laying, period from keel-laying to launching, and period from launching to outfitting, disappear, since these periods do not include the time consumed in preparing and erecting the pre-assemblies.

TABLE I. APPROXIMATE COMPARISON BETWEEN OLD AND NEW SHIPBUILDING METHODS

	FORMER BUILT-IN-PLACE METHOD (RIVETED)	MODERN PRE-ASSEMBLY METHOD (WELDED)
Sum of joint distances on pre-assemblies (miles)	10	29
Sum of joint distances in berths (miles)	31	12
Total of joint distances on ship (miles)	41	41
Number of pieces going into a ship	250,000	
Number of pieces in form of pre-assemblies		100 to 150
Range in weight of pieces or pre-assemblies (tons)	0 to 25	20 to 100
Man-hours per ship	600,000 to 700,000	300,000 to 400,000
Time required to construct ship (days)	60 to 80	30 to 40
Capacity of cranes on shipways (tons)	10 to 20	25 to 75

The use of pre-assemblies requires entirely different shop layouts and larger shop areas as compared with the older types of yards. Modern shipbuilding methods call for a dispersion of operations in suitable yard areas to provide freedom of action in fabrication and in building pre-assemblies. Such a spread of work permits considerably more men to work on the elementary parts of a ship under better working conditions and under better supervision, thus leading to better planning of the work and a more efficient utilization of manpower. The method used for transportation of units from points of pre-assembly to the launching yard further influences modern plant layout—as for example, rubber-tired equipment operating on paved roads, or an extension railroad system.



TWO CRANES ROTATING A BOW PRE-ASSEMBLY INTO POSITION FOR WELDING

The Design of Recent TVA Projects

III. Watts Bar and Fort Loudoun

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CONSTRUCTION of Watts Bar and Fort Loudoun dams added 110 miles of navigable waterway to the Tennessee River system. These low-head main-river projects are also invaluable for controlled flood storage and power development. Fundamental design considerations are discussed by Mr. Mundal in this article, third in the comprehensive series on the TVA system.

CLOSE similarity in natural physical conditions at Watts Bar and Fort Loudoun was conducive to liberal use of the principle of standardization. Whenever structural or mechanical elements developed for the first project could be adapted to fit the second, they were re-used with the minimum of changes. This not only resulted in savings in time and cost for design, but also facilitated the procurement of construction plant and equipment and permitted its re-use.

The project layouts conform generally with the functional requirements given in the introductory article; the spillway occupies the central position in the river, while the power station and navigation lock are located on opposite banks. A diagrammatic plan of the Fort Loudoun project appears in Fig. 1.

The two sites have as a common topographic feature a rock bluff rising steeply from the river at the west bank, while the east bank is an alluvial flood plain, the shore of which can be altered as desired. At both sites economical highway and railroad access for the power station could be obtained on the west bank only.

The elevation of the spillway crest was so chosen that, based on the required maximum flood-discharge capacity, the overall length of the spillway and the power station together would total approximately the width of the natural river channel below the site.

NAVIGATION REQUIREMENTS CONSIDERED

As regards navigation requirements, each site presented its own particular problem. At Watts Bar, the river starts to turn westward less than a mile below the dam. The sailing line at this bend follows the west shore, so that, to approach any lock on the east bank, it would be necessary to cross the river a short distance below the dam. To eliminate this impediment, studies were made to locate the lock at the foot of the bluff on the west bank, but foundation conditions ruled out this solution. The river bottom adjacent to the bluff is a hard sandstone formation, while at the east side a thinly laminated shale with a very low modulus of elasticity predominates. It appeared very undesirable to locate the power station, with its heavy load concentrations and rotating equipment sensitive to uneven settlement, on this shale, which, however, was adequate to support the much more uniform loads of the lock.

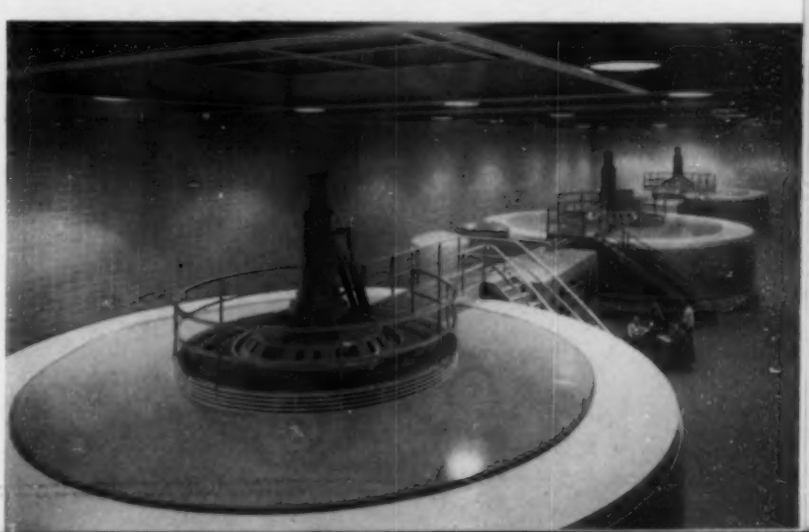
The final solution called for extensive remodeling of the shore of the flood plain and of an existing island to obtain, at a reasonable cost, a long, straight, protected approach to the lock and a navigation channel on the left shore extending a long distance below the dam. Where the sailing line now crosses the river, all waves and disturbances from the spillway have been dissipated and the backwater of the next project downstream operates to reduce velocities.

At Fort Loudoun, the lower lock approach required extensive shore-line relocation but was otherwise satisfactory, as the spillway discharge tends to move toward the deep channel along the west shore. Accordingly, a short concrete guard wall at the lower lock was adopted, permitting the omission of the non-overflow section of the dam between spillway and lock, thus reducing both earth and rock excavation in the lower lock approach channel. At the upper lock approach, the sailing line leaves the dam with a sharp bend away from the spillway. The current passing through and under the guide wall would tend to force traffic against the upper guard wall, and there would be danger that the last barges in the tow would sweep along the upstream wall towards the spillway. After model tests, this disadvantage was surmounted by extending the river wall upstream and at the same time shortening the land wall, thus setting up an eddy opposing the flow towards the lock.

LOCATION OF POWER STATIONS

In both projects the power stations were placed against the rock bluffs on the west bank. It was necessary to locate the switchyards on top of the bluffs. At Watts Bar the cliff extends 125 ft above the generator floor, and space for transformers at the foot of the cliff could only be obtained at prohibitive expense. The transformers were therefore located in the main switchyard. The shortest length for generator leads could be obtained by constructing a tunnel and shaft in the rock abutment. The control room then had to be located at some intermediate point between the power station and the switchyard, and the only available space was either at the foot of the bluff or on top of it. The top position was chosen because building space was available there at much less cost, and a large future extension of the switchyard was anticipated, making the ultimate volume of control cable much larger on the switchyard side than on the power station side. This expected expansion materialized even sooner than anticipated, owing to the construction of a new 240,000-kw steam plant on the west bank about a half mile below the hydro station.

The steam turbo-generators are brought up to speed by the operators at the steam plant, but synchronizing, dispatching, and all subsequent control operations are performed at the hydro control room. The control



UNOBSTRUCTED OPERATING SPACE WAS PROVIDED FOR GENERATORS, GOVERNORS, AND CONTROL BOARDS—WATTS BAR PROJECT

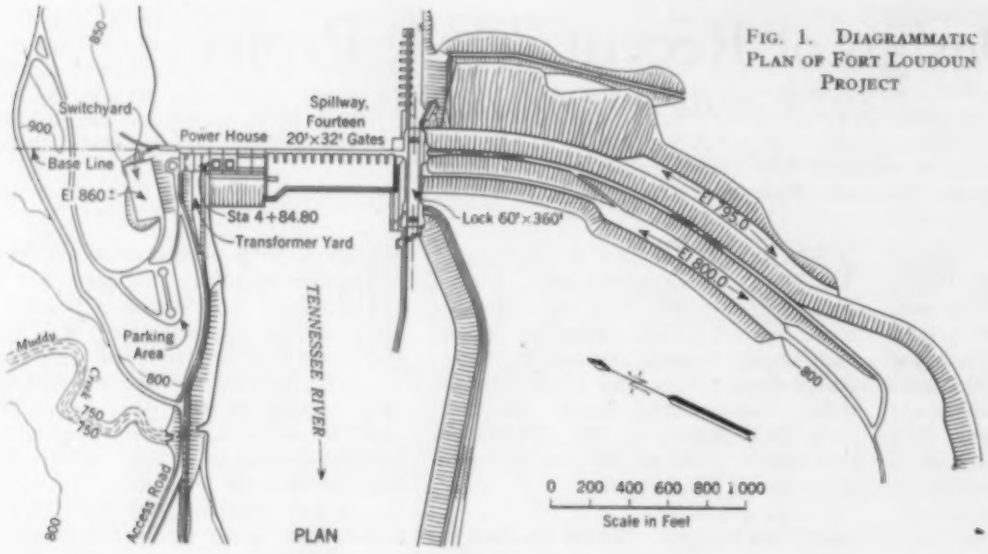


FIG. 1. DIAGRAMMATIC PLAN OF FORT LOUDOUN PROJECT

building includes offices for the Department of Operations and facilities for the visiting public.

At Fort Loudoun the rock cliff is comparatively lower, being only about 40 ft above the generator-room floor. Consequently the control and office building was placed on top of the cliff directly adjoining the service bay of the main power station. To obtain the shortest length of generator leads, the transformers are located on a platform downstream from the service bay, while the switchyard is terraced in the overburden of the hill back of, and above, the transformer banks.

POWER STATION ARRANGEMENT

It is believed that the arrangement adopted for the generator room deserves more widespread application. The generators are housed in a continuous unobstructed operating space (see photograph) in which governors and unit control boards are arranged in the manner usual for indoor power stations with conventional superstructures, and a roof is provided below the gantry crane, with individual hatches over each unit and over each of the two erection areas at the service bay.

Initial studies had contemplated a standard indoor type of power station; but the high tailwater would have required a prohibitively high superstructure to permit direct access to the highway and railroad with a crane of conventional type. In preference to indirect access (involving a secondary transfer crane) through a hatch in the roof or in the intake bulkhead, the semi-outdoor type was chosen. This resulted in excellent transfer conditions and a substantial saving in construction cost.

Liberal space for erection and assembly is provided in the service bay which is at the foot of the bluff. There the foundation rock rises steeply, giving a well-coordinated use of all available space with substantial economy in foundation costs. On the other hand, the highway and railroad approach to the service bay deck along the face of the bluff involved some special and relatively expensive structures. At Fort Loudoun, where geological conditions were difficult downstream from the service bay, a large concrete platform was provided, affording an excellent location for the main transformer banks, minimum length of generator leads, and comparative ease of transfer for the transformers.

In the case of Watts Bar, it was found necessary to construct turbine foundations before funds were available for the purchase of the generating units. By close cooperation between the four principal turbine manufacturers and the Authority's engineers, it was found to be entirely practicable to develop a single design of scroll case and draft tube that would be acceptable to all four potential bidders. This involved payment of a nominal sum to the manufacturers for a series of confirmatory model tests at their own laboratories, but this charge was trivial in comparison with the resulting benefit. This advance determination of turbine waterways also permitted pouring the major portion of the draft-tube concrete for the future unit substructures for both projects. The result was a much more rugged and substantially braced structure than would otherwise have been possible.

As outlined in the introductory article, the combined mass of the intake and the draft-tube substructure was utilized in sustaining the hydrostatic overturning load. To insure the most positive and direct delivery of load to the foundation rock, it was considered essential that the main piers of the structure extend in straight lines from the upstream face of the intake to the downstream face of the draft tube. This was accomplished by making the elbow type of tube unsymmetrical with respect to the vertical center line of the unit. The intake was shortened to the minimum by providing only a single internal slot for the main intake gate and using a compact structural steel guide attached to the upstream face of the intake for trash racks and emergency stoplogs.

The combined intake and draft-tube substructure is liberally reinforced to insure structural action as a monolith. To inhibit shrinkage cracks in the main piers, vertical openings 5 ft wide were left open until the advent of cold weather. These openings, located near the junction of intake and draft tube, extended upward from the intake mat through the entire height of the pier. When the atmospheric temperature fell below the final average for the structures, the final closure was poured.

The individual generating-unit structures were completely separated by contraction joints extending from the foundation rock to the top of the power station and

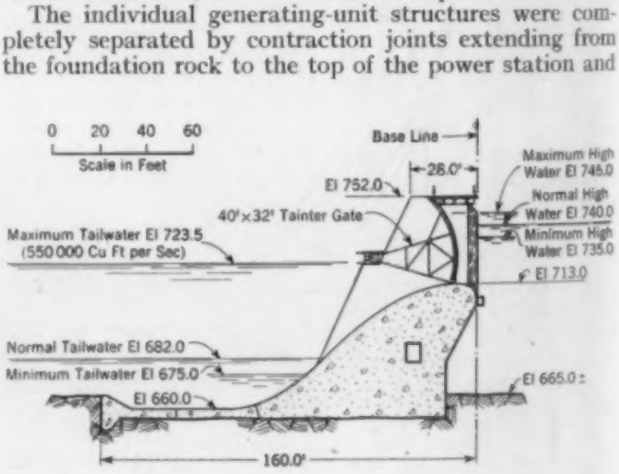


FIG. 2. SPILLWAY CROSS SECTION AT WATTS BAR PROJECT

intake. The seals in these joints are so arranged that tailwater is permitted to enter the joints and assist in balancing the hydrostatic pressure on the side wall of the outstream unit.

Horizontal and vertical construction joints were completely detailed in the design office, and the time interval between successive pours was specified so as to insure

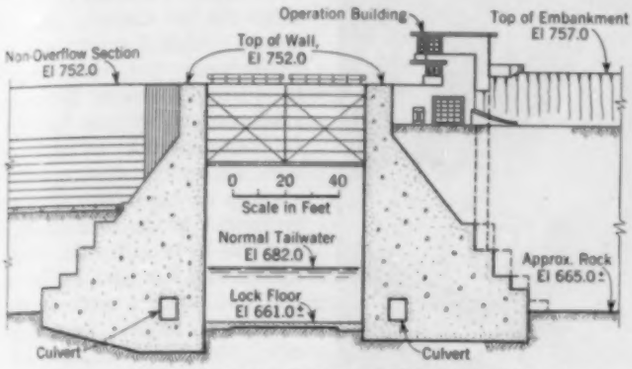


FIG. 3. CROSS SECTION THROUGH NAVIGATION LOCK, WATTS BAR PROJECT

adequate dissipation of the setting heat. This procedure reduces displacement and distortion of the speed ring and other imbedded turbine parts to the practicable minimum without penalizing unduly the rate of concrete placement.

Kaplan automatically adjustable propeller-type turbines were selected to obtain the requisite efficiency over a wide variation in head and load conditions.

Power from the generators at 13.8 kv is stepped up through the main transformers to 154 kv, the transmission system voltage. When the Fort Loudoun project was designed, the TVA power system had become so large as to warrant the use of one bank of transformers for each pair of generators. At the Watts Bar project, designed when the system was smaller, it was considered necessary to provide a separate transformer bank for each generator as insurance against undue outages.

GANTRY CRANES PROVIDED TO HANDLE POWER HOUSE EQUIPMENT AND GATES

A 225-ton outdoor gantry crane with runway on the power-station deck handles the heavy equipment; a jib on the downstream side takes care of the draft-tube gates. An extension to the upstream side for handling the intake gates could not be incorporated because of interference with the columns of the possible future overhead highway bridge. Consequently a separate 50-ton intake gantry crane had to be provided to operate between the bridge columns and beneath the future bridge deck. The erection bay at the generator-room level has a 10-ton indoor service crane.

Draft tubes and scroll cases are unwatered from a sump serving all units. The water flows by gravity to the sump and is pumped to tailwater level by two 5,000-gal per min pumps. This arrangement required a minimum of access openings to the pipes through the heavily loaded power-station substructure. Seepage from the spillway gallery and the power station is collected in a separate sump by two 300-gal per min pumps. This sump is connected with an overflow to the draft-tube unwatering sump for emergency use.

Since one of the main purposes of the projects is flood control, it is of the utmost importance that the spillway gates be capable of operation at all times. To safeguard against a complete loss of power, an emergency gasoline motor-generator set is provided, which can operate both these gates and the unwatering pumps to prevent flooding of the power station.

SPILLWAY DESIGN FOR THE TWO PROJECTS

The spillway is designed to discharge a maximum flood of 550,000 cu ft per sec for Watts Bar, and 385,000 for Fort Loudoun. The upper part of the spillway, with its gates and accessories, is identical on the two projects. Tainter gates 32 ft high by 40 ft wide were adopted, and two traveling gate hoists of identical design. Only one floating caisson for unwatering the tainter gates is provided for the two projects, since the intervening distance is relatively short. A typical cross section through the spillway at Watts Bar appears in Fig. 2.

The large size of the gates and correspondingly high trunnion reactions required special design of the anchorages. The gate load is transferred to the pier in compression by a steel grillage imbedded 18 ft from the downstream face of the pier. The grillage is connected to the trunnion support by steel bars, wrapped with burlap soaked in asphalt to prevent bonding with the concrete. These bars are kept under constant stress, which is accomplished by grouting the space provided between the trunnion support and the pier under the loaded condition. In erection, it was found convenient to secure the elongation of anchor bars corresponding to the loaded condition by means of electrical induction heaters. This procedure insures constant strain in the anchor bars even for carrying gate loads, keeps the trunnion-support face plates in contact with the concrete, and prevents rotation of the trunnion supports when the gates in neighboring bays are opened different amounts.

The ogee curve of the spillway was liberally proportioned for the limiting condition when the gate is opened a minimum amount with reservoir full.

Extensive laboratory tests were made to determine the most economical design of apron consistent with the minimum amount of scour below the dam and a minimum of objectionable wave action from the spillway for the maximum flood discharges at which it is feasible to keep the river open for navigation. By limiting the differential in opening between any two gates to 2 ft, it was found that a flat apron about 75 ft long with a deflector weir 5 ft high at the downstream end would be satisfactory for the intermediate portion of the Watts Bar project. At Fort Loudoun the width had to be in-

SPILLWAY AND POWER STATION AT FORT LOUDOUN PROJECT

SPILLWAY AT WATTS BAR PROJECT DURING CONSTRUCTION

creased to about 100 ft and the height of the deflector weir to 10 ft. At the ends of the spillway the aprons were made wider to counteract a more pronounced tendency toward severe scour. In addition, the downstream ends of the apron and the training walls were carried to a considerable depth to safeguard against undermining.

Contraction joints in the ogee section, on the center line of each gate opening, separate the mass concrete into independent blocks 46 ft 6 in. long.

On the Watts Bar project, the spillway foundation consists generally of alternate bands of shale and sandstone with sharply defined boundaries. Wherever feasible, the rock was excavated along the dip joints and stepped up at the contraction joints so that each concrete spillway block was located entirely on one formation. The contraction joints at these steps were provided with two vertical holes along the joint to be filled with asphalt if differential settlement or deflection should break the standard copper seal. The apron has continuous reinforcement but no contraction joints, and is doweled to the mass concrete at the toe of the spillway.

GRAVITY-TYPE NAVIGATION LOCKS OF CONVENTIONAL DESIGN AT THE TWO PROJECTS

Both projects have gravity-type locks, single lift and of conventional design. They exceed in height any single-lift lock previously constructed. [See the Page of Special Interest, April issue.] A typical section through the one at Watts Bar is shown in Fig. 3. Because of the high heads, extensive investigations of the filling and emptying systems were conducted in the hydraulic laboratory to insure that the size, number, and spacing of culverts and the shape of ports would reduce turbulence in the chamber to a minimum during lockage. Operating conditions in the prototype indicate that lockage is quieter than in most low-head installations.

On previously constructed TVA locks, considerable disturbance had been observed below the lower gates when the emptying system discharged directly into the approach channel. To alleviate this difficulty, a new system was adopted on the Watts Bar and Fort Loudoun projects, to discharge through the dike or river wall to the river on the spillway side. Elimination of the culvert discharge ports from the lock walls below the gates afforded a considerable saving by shortening the land wall on the downstream side.

Lock walls are of the conventional gravity type. At Watts Bar the natural limitations of the rock foundation imposed special restrictions on the design. The thinly bedded sandy shale underlying the rock was found adequate for bearing loads up to 10 tons per sq ft, but special provisions were taken to ensure against sliding. The base of the river wall of the lock chamber was keyed into the rock 6 ft at the toe and 12 ft at the heel, with a uniform intervening slope. In addition, the vertical face between the concrete and the rock at the toe was grouted to ensure positive bearing. This design was based on field tests of the shear-friction resistance of the rock under conditions as close to the actual loading as feasible.

At Watts Bar the available materials were suitable for a commonly used type of embankment, that is, an impervious core and pervious shoulders rolled to a 1-on-3 slope in the upper portion and a 1-on-4 slope in the lower portion. At Fort Loudoun the available borrow-pit material was almost all impervious and of rather low strength. Foundation material of the embankment located in the old river bed was gravel of ample strength, but that on the flood plain was impervious and of lower strength. By careful selection of borrow, so that the best was placed near the upstream face, it was possible to design the top 35 ft of the embankment with a 1-on-3 slope. Below this level the embankment slopes in the river bed were strengthened by blanketing heavily with sluiced fill obtained cheaply from dredged excavation in the lower lock channel. On the flood plain, wide berms not only provided the strength necessary for the embankment but also blanketed and strengthened the foundation. The construction schedule made it economical to place the downstream blanket early, with material obtained by dry excavation in the lock channel. The upstream face of this initial fill then provided a surface against which to place a gravel blanket to act as a drain for the remainder of the impervious embankment.

At Watts Bar the lower part of the overburden was fairly pervious, and a cutoff of steel sheet piling was specified for this part. This design indicated a considerable saving over an open cutoff trench. Since the rock below was tight soft shale, the steel piling could be driven into it and sealed tight. At the end of the embankment, where the rock elevation was considerably higher, an open trench backfilled with rolled impervious material was specified. At Fort Loudoun a cutoff was required only on the north half of the embankment through the gravel in the old river bed. In this case an open cutoff trench was economical.

Embankment slopes in areas subject to wave action are riprapped. The downstream slope above the riprap is protected from erosion by a continuous mat of honeysuckle, adopted because of expected low maintenance cost. Grass cover has been found unsatisfactory for this location, even with continuous maintenance.

The Alaska Highway—Effect of Climate and Soils on Design

By A. C. CLARK

PRINCIPAL HIGHWAY ENGINEER, U.S. PUBLIC ROADS ADMINISTRATION, WASHINGTON, D.C.

THE speed with which the Army pioneer road was pushed through the Canadian-Alaskan wilderness did not permit careful consideration of soil conditions. It was therefore necessary to relocate certain sections through more favorable materials. Mr. Clark, in this paper presented at the recent Annual Meeting of the Society in New York, explains the unusual soil and climatic conditions that were encountered and their effect on design.

ON a project of the magnitude of the Alaska Highway, the design problems encountered are naturally extensive and varied. They range from those ordinarily found in the States to those peculiar to the "bush country" of the Far North.

The project lies between latitudes 55° and 65° north. It begins at Dawson Creek, British Columbia, and extends northerly through the upper reaches of the Great Plains east of the Rocky Mountains, thence along the rolling foothills to Fort Nelson. From there it ascends to the summit of a range of the Rockies, 102 miles distant, at an elevation of 4,350 ft—the highest point on the route. After descending to a crossing of the Liard River, it traverses a high plateau on ascending grades to a crossing of the Stikine Mountains on the continental divide at 3,300 ft. This crossing is approximately 190 miles southeast of Whitehorse. From the divide to the northern terminus it is on a high plateau at an average elevation of 2,000 ft, broken by drainage channels of varying sizes. The entire route lies east of the Coast Range, the highest and most scenic mountains of this northern region.

These mountain ranges are so located as to have a marked effect on climate, and may be said to divide the region into two general classifications—marine and continental. The marine climate along the coast is characterized by moderate temperatures and heavy precipitation. The continental climate of the western great plains and interior valleys is characterized by a wide temperature range, with extremely low temperatures during the winter months, and light precipitation.

Extreme low temperatures of −57 F at Edmonton and −66 F at Fairbanks have been recorded. Average minimum temperatures are freezing or lower from September to April in the Tanana and Yukon River valleys and generally from October to April or May over most of the great plains and interior valley areas for which data are available. In the interior valleys and over the western great plains, the maximum precipitation occurs in summer, and annual amounts usually range between 10 and 20 in. Snowfall over southeastern Alaska, the Yukon Territory, and British Columbia, varies from 2 to 5 ft. It is obvious that climatic conditions, although severe, are not entirely dissimilar from those in some sections of our northern states, except possibly for the longer winter.

Surface materials run the gamut from solid rock to muskeg. Discussions of the highway construction in the public press, before detailed field studies had been made, laid great emphasis on the difficulties anticipated in crossing the muskeg swamps of Canada. These swamps do exist but it was a simple matter to swing the location between Fort St. John and Fort Nelson over to the foothills slightly west of the direct line, thereby avoiding all such areas except those formed by cross drainage. Of the 300 miles between Dawson Creek and Fort Nelson, swampy conditions were encountered over a distance of 33 miles. On sections totaling 30 miles, the unstable material varied in depth from 1 to 5 ft; on 1.3 miles, from 5 to 10 ft; on 0.7 mile from 10 to 20 ft; and on a 1-mile section, over 20 ft with a maximum of 26 ft.

The best procedure to insure a stable embankment across these areas, and one practiced by Canadian engineers on the Trans-Canada Highway north of Lake Superior, is to excavate all the unstable soil and backfill with selected material. On account of the large yardage involved in the deeper swamps, it is probable that some modification of this plan, such as underfill blasting, may be adopted.

Subgrade design follows standard practice. Three layers above the natural soil are provided—selected borrow, base course, and surface course. The surface and base courses are each 4 in. thick, while the thickness of the selected borrow is varied between 6 and 16 in., depending on the classification of the subgrade soil. Selected borrow is being obtained from deposits of fine sand, sandy gravel, or from sandstone ledges. Most ledges require drilling and blasting, but although the rock comes out quite blocky, it is not necessary to crush it, as it readily breaks down during normal subgrade shaping operations.

Base-course material is being obtained from gravel deposits and sandstone ledges. It is crushed to a 2-in. maximum size, the gradation being controlled to give a dense, stable base. Where sandstone is used, the harder ledges are selected, but it is necessary to place the surface course immediately to prevent detrimental abrasion of the base.

Surface-course material is being obtained from sandy gravel deposits. The material is crushed to a 1-in.

MEANDERING STREAMS CHARACTERIZED THE POORLY DRAINED, GLACIATED REGIONS

WHERE THE HIGHWAY SKIRTS A MOUNTAIN LAKE

maximum size and the gradation and quality are carefully controlled. Only hard, durable aggregates are used in this course.

A troublesome but important problem is the compaction of heavy clay soils. These are difficult to excavate and are massive and rubbery when placed on the grade, with a moisture content above the plastic limit even in the driest seasons. This condition necessitates considerable manipulation. Sheepsfoot rollers are used for compaction, and it has been noted that they also speed the drying process by reducing the size of the lumps.

ALLUVIAL FANS CROSSED

Through the mountain sections, considerable water is encountered under all varieties of conditions. Many drainage ditches and subdrains will be required. Serious problems develop where the road crosses large alluvial fans at the mouths of box canyons. In the summer, very little water flows from these canyons, but during the spring break-up, or during heavy storms, enormous quantities of water and debris are poured onto the fan. Many of the streams flood practically the entire floor of the valleys through which they flow. Some freeze from the bottom during the winter and build up large deposits of ice, which block all ordinary drainage structures. These problems are now being studied to determine the best solution; this may be to place grade lines high and use channel jetties for control, or to avoid such areas by routing the highway around them.

The advance and retreat of the glaciers were responsible for many changes in the established drainage systems. Some streams were dammed, forming long lakes, such as Lake Teslin; the channels and valleys of others were filled, necessitating the development of new water courses; new divides were created; the direction of flow of parts of some streams was reversed; and the drainage systems of many broad, low areas were destroyed. That these changes were comparatively recent is indicated by the fact that good drainage has not been satisfactorily reestablished in many areas. As a result of these changes, the streams meander considerably, although their velocities are not low and there are numerous swamps and marshes. These generally are not over 3 or 4 ft deep, and are underlain by material suitable for embankment foundations. The number of swamps that have been located on the line is small.

The lack of well-developed drainage systems contributes to the formation of areas of frozen ground protected from thawing by an insulating blanket of moss. It is estimated that 100 miles of such ground may be encountered in the Yukon Territory and less in Alaska. The existence of this perpetually frozen ground at varied depths below the surface is one of the most unusual features of this area. A thickness of as little as 3 in. of moss seems sufficient to prevent thawing in many cases. Except for this one ground condition, the problems of actual construction in this area would be relatively simple, since much of the soil is fine silty sand. Also, there is an abundance of good gravel, sand, and rock for selected borrow or surfacing, and generally within short hauling distances.

Permanently frozen ground or ice may occur at almost any depth. Most commonly it is close to the surface in relatively flat areas and immediately under a heavy insulating layer of moss or grasses. Formations of this character are called arctic tundra. In addition to moss, the covering consists of low-growing bushes and "niggerheads"—a local term for the hummocky grass found in relatively flat areas where the drainage is too poor to permit other vegetation. Scattered scrub black spruce trees occasionally grow in the "niggerhead" areas, and are frequently found in areas covered by heavy moss or ground vegetation.

Since the ice or frozen ground occurring immediately under heavy vegetation will generally be found in low areas, the problem faced by the highway engineer is that of constructing a stable embankment. Good material will be available for the embankment itself, but the foundation will often be of doubtful supporting value. In constructing the truck road during the 1942 season, the time factor was of the greatest importance, and embankments were placed across these areas by the quickest feasible method, generally corduroying with brush and poles, and following with a light fill of good granular material. However, for the permanent highway this

SPREADING GRAVELLY MATERIAL FOR TEMPORARY SURFACING

method is not recommended wherever it can possibly be avoided.

Wherever a more solid foundation can be reached by stripping the vegetation, this should, of course, be done. If this stripping uncovers a frozen silty-sand, it greatly increases construction difficulties and results in a foundation which, for some time at least, is anything but stable. If the weather is warm the underlying ground begins to thaw, and since the water thus released cannot drain downward, it further softens the surface.

If the soil is a fine silt-sand, as is so common, it quickly becomes a quagmire incapable of supporting equipment for further construction operations. Also it will not adequately support an embankment. Until the excess water is removed by drainage or by evaporation, a stable embankment cannot be expected. Experience indicates that if time is available, the most satisfactory method (from a permanent construction standpoint) is to clear the right of way, strip the vegetation with bulldozers, shape the surface thus exposed so that water will drain off, and then leave that part of the work alone until it has had time to become relatively stable.

This method has been extensively used by the Alaska Road Commission on many miles of highway constructed by it. Sections of the new highway where frozen ground originally occurred at the grass roots were treated in this manner and, after a two-month period, they thawed to a depth of 7 ft or more and became relatively dry and stable. While this method involves extending the work over considerable distances, it need not delay operations if they are planned with it in mind, and if the clearing and stripping are done far enough in advance of the actual grading. Clearing and stripping to a considerable width are essential to provide the necessary exposure.

In certain areas, so flat or so low that drainage is impracticable, it is not considered advisable to strip the vegetation unless the underlying material is naturally stable even when saturated, such as a coarse sand or gravel. If the vegetation is not stripped, a fill of 3 ft or more should in all cases be placed. The lower part of this fill should be a porous, granular material that will permit the escape of water released by thawing and forced out by the weight of the fill. While the moss will lose some of its insulating value when compressed, this apparently would be compensated for by the insulating value of the fill, so that no thawing would take place under it. As a factor of safety against unforeseen developments, fills should have broad bases and flat side slopes. When temperatures and other conditions permit, consideration may be given to stripping the moss and placing the fill directly on the frozen ground before thawing occurs.

LOGS FOR A TEMPORARY BRIDGE BEING PLACED BY AN ADVANCE CREW
Men Are Wearing Masks for Mosquito Protection

Layers of ice and frozen soil occurring at depths of 3 ft or more present a problem much more difficult than those near the surface. Such layers vary in thickness from a foot or two up to perhaps hundreds of feet. Such a condition in a cut may make construction operations so difficult that it will be advisable to change the location or to raise the grade line above the frozen layers, which are almost as difficult to remove as solid rock. They present the additional complication that they start to melt as soon as the surface is exposed. This quickly produces "soupy" material in which it is almost impossible to operate equipment. The thawed material contains such a high percentage of water that it cannot be safely placed in embankments. In such locations it is desirable to excavate one or more feet below grade and backfill with sandy material before thawing occurs. As would be expected, the material in the side slopes of such cuts has a tendency to flow as it thaws.

Another ice condition which causes a great amount of trouble is that known as "glaciering," or the building up of ice formations during the winter. Water may seep from the side slopes and cause a continuous build-up of ice across the road. This ice must be removed periodically. "Glaciering" may develop in stream channels from the continual freezing and subsequent overflowing of the stream water. Such action may eventually cause the stream to overflow nearby road sections, and ice may be built up high enough to endanger bridges. Local aviators have reported that at some locations on present highways in Alaska, which were not in use during the winter, the streams have "glaciered" high enough to completely encase small truss bridges. Others have reported as much as 50 ft of ice in stream channels by spring.

ONE TRACTOR HELPS ANOTHER OUT OF A QUAGMIRE CAUSED BY MELTING ICE

POROUS SIDE-SLOPE DRAINS

At some locations, seepage from cut banks may be intercepted by porous drains. However, extreme precautions will be necessary to keep these drains open during the winter. No doubt thick layers of the arctic moss so common in Alaska can be used to good advantage in insulating drains, particularly near the outlets. Installations of this kind have not been tried on the road so far constructed. Wherever possible the road has been located away from areas where side-hill or through-cut seepage is expected.

GRAVEL OF TEMPORARY SURFACE EXTENDED OVER A POLE BRIDGE

Where "glaciering" occurs in stream channels near road crossings, the problem is more difficult. These streams are generally of the smaller, swifter-flowing type, and it will probably be helpful to build dikes on each side of the channel and extend them upstream for a considerable distance. Confining and straightening the channel, by accelerating the flow, will not only reduce the deposition of stream-carried debris but will also retard the formation of ice.

Frost heave and the spring thaw are the controlling factors in providing a surface with adequate bearing value. Solution of the problem lies in the provision of a course of granular material to prevent capillary rise and distribute traffic loads and impacts, and an adequate drainage system to assure the removal of water from the immediate vicinity of the roadway. As the portion of clay and silt subgrade immediately above the frost line during a thaw may become quite plastic, a layer of sand 4 to 6 in. thick should be provided to avoid fouling of the subgrade reinforcement.

All the problems on the Alaska Highway involve the effect of water on the stability of soil. Therefore it is of the utmost importance to design a well-drained roadway. The provision of wide ditches of ample depth, together with maintenance to remove ice and snow during periods of alternate freezing and thawing, will go a long way towards promptly draining all water away from the roadway.

Throughout the section of Alaska in which the new highway is located, the average annual precipitation is light, and snow removal will not be a serious problem. However, considerable trouble in the spring of the year may be expected from high water and floating ice. Bridges will have to be built with long spans and ample clearance. Piers and abutments must be protected against the ice. Generally speaking, pile trestles will not be satisfactory for permanent bridges since they offer too much obstruction.

STANDARD ROADWAY SECTION ADOPTED

It was recently agreed in conference with the Chief of Engineers' staff that the standard section originally adopted for this highway—a 24-ft surface with a 6-ft shoulder—will be adhered to throughout, except in heavy cuts and in rock. In laying the grade line, the object will be to provide drainage and protection from capillary moisture. Therefore much of the completed roadbed will be at a higher level in relation to the surrounding ground than the existing pioneer road. The grade line will be rolled with the contour of the country as far as practicable, and no attempt will be made to produce long grade tangents. Vertical curves will be flattened to provide safe sight distances, with a 1,000-ft sight distance as the ruling minimum except where excessive yardage would be involved.

On fills less than 2 ft deep, slopes will be flattened to 2 ft horizontal to 1 ft vertical, further depth of fill to take the natural slope. In frozen ground, consideration will be given to using 4:1 slopes on shallow fills, and these slopes may be further flattened even on higher fills if present winter observations indicate the necessity for it.

Standards of alinement and grade will be influenced by those used in constructing the existing Army pioneer road. The following standards were originally agreed upon and may be approached where deviations are desirable and are approved by the Division Engineer of the U.S. Engineers:

Ruling grades not to exceed 5%, maximum grades 7%; curvature on prairie terrain not to exceed 3°; in mountainous sections, on open sight distance 19°, and 16° where the sight distance is obscured or blind; all curves to have standard spirals and widening of roadbed for curvature above 3°.

It will be necessary to put forth every effort to complete the highway in 1943 to a crushed stone or crushed gravel surfacing standard. Construction will be in progress over practically the entire length of the project, and final hard surfacing operations cannot be undertaken until the grading is stabilized.

It is desirable to defer the placing of a high-type surfacing until after the road has been subjected to a season's traffic, during which time corrective measures can be undertaken to insure an adequate subbase. Meanwhile, consideration must be given to a bituminous surface.

The field engineers of the Public Roads Administration have made a careful study of all factors influencing highway design on this project. Data assembled by the materials and soils engineers will be particularly valuable in effecting economy and permanency of design. Credit is hereby given to Messrs. L. A. Deklotz, Worth D. Ross, William L. Eager, Assoc. M. Am. Soc. C.E., and W. J. Liddle, Materials Engineers on the project, who furnished the data included in this report on soil and general topographic conditions.

ELEVATING GRADER AND SCRAPER TYPICAL OF CONTRACTORS' EQUIPMENT IN USE ON THE WORK

Arched Concrete Shell for Industrial Roof

Design Chosen for Extension to Westinghouse Plant

By H. C. SCHWERIN

FORMERLY CONSTRUCTION ENGINEER, WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, PITTSBURGH, PA.

TO avoid the use of materials on the critical list, reinforced concrete was chosen for the new addition to a Westinghouse plant. Its outstanding feature was the arched shell roof, the design of which was based upon analysis of the action of an inverted pressure vessel. The construction procedure, here described by Mr. Schwerin, called for the use of traveling roof forms carried on the concrete crane girders.

AS a result of defense orders, manufacturing facilities and floor space at a Westinghouse plant became inadequate, making necessary the expansion of existing steel framed buildings. Therefore, the construction department was requested to make preliminary studies to provide an addition to an existing structure. The addition was to be 1,127 ft long and 160 ft wide, and to consist of three crane aisles, two of 55 ft and one of 35 ft. The crane rail was to be 35 ft above the floor at the side aisles and 45 ft at the center aisle.

INTERIOR OF COMPLETED STRUCTURE
Openings in Columns Are for Service Ducts

The Westinghouse construction department, after careful consideration of various types of construction, and in line with its policy of cooperation with the Government, decided to avoid the use of materials on the critical list as far as possible and to adopt a design using local materials. This would also avoid delay. An adequate and satisfactory local supply of sand, gravel, cement, and brick, and an ample supply of labor indicated the practicability of a reinforced concrete structure. After various studies, the Z-D type of design developed by the Roberts and Schaefer Company of Chicago was found adaptable to the problem, and this firm was engaged for the reinforced concrete design of frame and roof. The Westinghouse construction department developed the architectural design for the rest of the work.

COMPLETED ROOF OF CONCRETE BUILDING
Strengthening Ribs Are 50 Ft Apart

The structural-frame design provides for three crane aisles, respectively 39 ft 3 in., 58 ft 10 in. and 59 ft 8 in. wide center to center of columns, with column bays spaced longitudinally on 25-ft centers. Reinforced concrete columns are 3 by 2 ft in section and are cast integrally with the footings. Columns have knees cast to their sides for the support of the reinforced-concrete crane girder, and then continue up to support the girder forming the edge member of the arched concrete roof shell. This shell has a radius of 45 ft and varies in thickness from $3^3/_4$ in. at the top to $6^1/_2$ in. at the edges. Each 100-ft length of the building is an independent, self-sustaining unit, separated from the next section by an expansion joint. Each section consists of four bays 25 ft long. This arrangement provides for an arched ceiling free from all obstructing ribs and permits the use of movable forms.

On the side next to the existing building, the arch shell roof and crane girders are supported on steel brackets attached to the existing structural steel columns in the outside wall of the older structure. The roof-shell design is based on the theory of an inverted pressure vessel. It is characterized by direct stresses rather than the bending stresses usual in beam-like action. Each 100-ft section has a transverse roof frame 25 ft from each end, that is, 50 ft apart, thus forming a support for a 25-ft cantilever of arc shell each way. The end of each 100-ft section is in turn reinforced with a 9 by 16-in. concrete rib. The reactions of the rectangular concrete dome are thus carried to the longitudinal concrete beams and to these transverse frames.

TRAVELING ROOF FORMS USED

Timber forms were used for the columns and crane girders. These differed little from those quite generally used, with the exception of the steel beams which supported the forms for the crane girders. Preliminary examination of soil conditions indicated the impracticability of shoring the forms from the ground. Steel beams spanning the 23 ft between columns were placed on temporary supports resting on the column footings. The wooden girder forms were then supported on the steel beams. The units were moved along to new locations as soon as the concrete girders could be stripped. This method also permitted a clear working space between columns at the ground level. The total weight of steel shapes necessary for this operation was negligible.

PLACING REINFORCING STEEL FOR A 100-FT SECTION OF THE ARCHED ROOF

As the plan of pouring the roof required the use of a crane girder to support the roof form, these girders were cast ahead so they would have time to develop strength before loads were imposed. The crane rail was placed on the crane girder and secured in position to hold the flanged wheels supporting the wood trusses of the roof forms. In each aisle two complete sets of arched roof forms were provided. Each set was 100 ft long, so as to support one complete unit of the building. Each form unit consisted of 15 wood arches with arched top chord, supporting 3 by 8-in. roof rafters, over which $^{5}/_{8}$-in. plywood was nailed.

During pouring, the trusses of the roof forms were jacked clear of the wheel support; then for decentering, the jacks were lowered so as to drop the forms clear of the concrete and permit them to be rolled forward to the next position. Two 100-ft form units were used in each aisle and set to provide a 100-ft gap between each set-up. This made it possible to move the forms forward in sequence, and allowed for the setting time of the concrete. The cycle of form relocation was 7 days. The angle of slope of the top of the concrete roof shell at the edge member was such that outside forms were not found necessary. Concrete with little slump was used to avoid running. Reinforcing of the roof shell consisted of straight $^{1}/_{2}$ and $^{3}/_{8}$-in. bars which easily followed the curvature of the arch without bending. Column and girder reinforcing was typical.

LOCAL MATERIALS USED

The concrete mix was designed to use local sand and gravel with high early strength cement. Concrete for column footings was designed to have a strength of 2,500 lb per sq in., and that for girders, 3,000 lb per sq in. The roof shell, and the members integrally cast with it, were poured with high early strength cement concrete designed to have a strength of 2,500 lb per sq in. at 7 days to permit moving of the forms every 7 days. General data are given in Table I.

A batcher plant for fine and coarse aggregate was set up at the site, and a 1-cu yd mixer was used. A caterpillar crane with 110-ft boom lifted the concrete in a 1-cu yd bucket to a hopper set on top of the arch. From the hopper the concrete was moved in buggies across the form on runways and dumped in position. Columns and beams were poured direct with the crane, using a bottom-dump bucket. As all the concrete work was carried on through the winter months, protection against freezing was necessary. The lower chord of the trusses in the roof form was enclosed with flooring to provide a heating space under the shell In the aisle next to the existing building, four blower-type, high-pressure steam heating units were used to avoid the hazard of fire. In the other two aisles oil-burning salamanders were used as they were more economical.

TABLE I. GENERAL DATA ON THE PLANT EXTENSION, EXCLUSIVE OF FOUNDATION

Concrete volume	9,436 cu yd
Reinforcing steel	2,188,550 lb
Form area	461,130 sq ft
Floor area of building	166,300 sq ft

The top of the shell was enclosed with tarpaulins, which were supported slightly above the roof surface to provide for the circulation of warmed air.

Forms were removed only after tests on concrete cylinders indicated a strength consistent with the design assumption. The work was completed in five months.

FORMS FOR THE ROOF SHELL TRAVELED ON THE CONCRETE CRANE GIRDERS

Mapping Canada in Peace and War

A History of the Extension of Controls Through a Vast Undeveloped Terrain

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SURVEY LINE ON ONTARIO-MANITOBA BOUNDARY

LOW population density has handicapped the work of surveying and mapping in the vast Dominion. It has always been a great effort to raise money for the work. This situation has been a healthy one in that it has led to constant improvement in methods and the development of equipment and skills. A striking contrast is here drawn by Mr. Peters between the early surveyor with his compass and the modern flying photographer. This paper was presented before the Surveying and Mapping Division at the joint meeting of the Society and the Engineering Institute of Canada, which was held at Niagara Falls, Ontario.

A VERY early map indicating with some clarity what is now Canada was produced by Sebastian Cabot and dated 1544. From that time onward the territory of Canada has been progressively depicted—by discoverers, explorers, surveyors, geologists, and trained topographers and hydrographers.

The first legal survey in Canada was made in the Province of Quebec in the year 1626, by no less a personage than the founder and first governor of New France—the illustrious Samuel de Champlain. The earliest organized and accurate map was that of Admiral Samuel Holland, who commenced a survey and map of Prince Edward Island in 1764. At this time a general survey of British North America was ordered and he was appointed as "Surveyor General for making a correct survey of the Northern District upon the Continent of America."

Generally speaking, the early maps of eastern Canada, from the time of its settlement until the Confederation in 1867, were compiled in the office—either officially or privately—from the plans of legal surveys, which had been executed to lay out land grants. Outside the perimeter of these, information secured from explorers, who usually followed river courses, was used to extend the maps, but there were many blank spaces.

While these interior surveys were going on, the exterior limits were being charted with considerable accuracy by the British Admiralty. The Admiralty charts of the Arctic regions from 1576 onward bear reference to many well-known explorers—Cook, Back, Franklin, Gordon, Kellett, Parry, and Richards.

The history of those vast areas west of the Great Lakes is somewhat different because, prior to the construction of the Canadian Pacific Railway in 1885, there was no considerable settlement and no need for extended legal surveys. The maps of this great interior area were largely compiled from information gained by the Hudson's Bay Company and its progenitors and early rivals.

In 1791 Captain Vancouver was sent by the British Government to take over from the Spanish the territory along the Pacific Ocean. He immediately began a survey and charted the coastline of Vancouver Island and that of the mainland from the Strait of Juan de Fuca to latitude 60°. The gold rush led to further exploration.

PACK TRAIN OF AN EARLY SURVEY PARTY IN BRITISH COLUMBIA

SURVEY COMPASS AND OTHER EARLY INSTRUMENTS

As regards methods, up to 1850, roughly speaking, the survey compass was in vogue, and with the uncontrollable and inconsistent deviation of the magnetic needle, that type of survey left much to be desired on the ground of accuracy. By 1867 the theodolite was coming into its own, and since then there has been little radical change in ground survey instruments, save perhaps in the measurement of distance by the stadia and range-finder, which have displaced the earlier micrometer. The link measuring chain gave satisfactory results for ordinary field measurements, and the steel band or tape was not unknown, although it has since been improved in the constancy of its coefficient of thermal expansion by the introduction of Invar metal, which has practically none. The receipt of accurate time signals by radio reception is a radical improvement over the former procedure of carrying chronometers long distances into the wilds.

A great disparity has always existed between the small population and the great area of Canada. This has had a marked effect upon its surveys and maps. To adequately map great areas costs amounts of money which are difficult to procure from a small population of taxpayers. Accurate surveys and maps are an urgent need for the orderly and economical development and administration of any young country, but it is difficult to convince the public of this need. In Canada as in most democratic countries, mapping appropriations have been meager.

This situation has had its good side because those directing the surveys have always had to count their pennies, and have seen to it that all their funds were

SURVEY CAMERA AND TRANSIT USED IN HIGH MOUNTAINS

carefully expended. Following the adage that necessity is the mother of invention, they have been in the forefront in developing technical methods of the greatest speed and economy. Witness the ground survey camera used in mapping the western Cordilleras, the aneroid barometer by which the sectional maps of the western prairies were successfully contoured, and the early development of the method of oblique air photography. This latter has made possible the mapping of comparatively smooth terrain in northern areas which are beyond the limits of ground transportation facilities.

MERIDIAN AND BASE-LINE CONTROL

The year 1870 saw the beginning of the first large organized and accurate survey with the initiation of the Dominion Land Survey in western Canada. The organized control by meridian and base line was scientifically preplanned, with the benefit of all the experience gained on similar work in the United States. The accuracy of the survey on the ground was far in advance of anything done before. Eventually it covered all the southern half of Manitoba, Saskatchewan, and Alberta and a small portion of British Columbia. Serving as it did later on for mapping control, it has produced the finest example extant of a perfect connection between the topographical map and the cadaster.

It is most important that there should always be an intimate connection between the cadaster, or legal survey, and the topographical map. Accurate relationship between the topographical features on the ground and the legal boundary lines is thus insured. This is one of a number of reasons given in support of the view that the professional staff of mapping organizations should always be trained surveyors.

In 1886 the ground photographic method was introduced by Dr. E. Deville for the survey of the Rocky Mountain region. Here the ordinary methods of topographic surveying were too slow and expensive; rapid surveys based on a triangulation and on sketches were tried and proved ineffectual; and finally photography was resorted to with satisfactory results.

The photographic survey work done in Canada is noteworthy because nowhere else in the world has it been carried on so extensively or so successfully. Furthermore, a number of surveyors were trained in the science and practice of this method, so that after the last great war the way was prepared for an early understanding of the possibilities of mapping with the air survey camera.

In 1891 the Sectional Map Series was commenced as an office compilation from the returns of the Dominion land surveys, but lacking contours these maps scarcely met the requisites of a true topographic map. In 1919 the revision of these sheets was begun by field surveys to obtain the contours and other details so as to produce complete topographic maps. Batteries of aneroid barometers were used to obtain elevations between spirit-level controls. A standardized technique produced a reliable and consistent accuracy never before attained by the use of aneroids.

IMPORTANT PART PLAYED BY GEOLOGICAL SURVEY

The Geological Survey, born in 1842, has played a very important part in the exploration, survey, and mapping of Canada. Its maps were made mainly to record the location of geological formations. Up to about 1894 the mapping in the west and northwest was the result of exploratory and reconnaissance surveys, but in this year regular sheet mapping was undertaken on the scale of 1 in. = 1 mile.

About the year 1900, a need was felt for geodetic control across the country. Military and civilian organizations expressed the desire for accurate one-mile topographic maps of the well-settled districts. The movement was supported by the Canadian Society of Civil Engineers, now the Engineering Institute of Canada, and discussed at meetings of the Royal Society of Canada.

In 1903 the Chief Geographer issued the first sheet of the Standard Geographic Series, which up to 1933, when the maps were discontinued, was extended to cover the southerly part of Ontario and Quebec, the Maritime Provinces, and a portion of southern Alberta and British Columbia. These maps produced nothing new in the way of surveys because they were compiled in the office from existing information and without contours. Issued at two scales (3.95 and 7.89 miles to the inch), they are interesting because for about 25 years they were the best maps available of the areas they covered.

In 1904 the Geographical Section, Department of National Defense, may be said to have had its beginning. The first sheet mapped included the City of Niagara. The survey was designed for a sustained effort, to produce standard 1-mile-to-the-inch topographic maps, in keeping with the best practice of today. The sheet areas were prearranged with boundaries fixed by graticule lines so that eventually all would fit accurately together without gap or overlap.

WHERE LINE CROSSES WATER, TRIANGULATION MUST BE RESORTED TO—WITH CONSEQUENT LOSS OF TIME

Originating as a plane-table survey to the standards of the Ordnance Survey of Great Britain, the Geographical Survey now utilizes air photographs. Apart from certain special needs of the Defense Department, the work has been mostly concentrated in the more densely settled part of Ontario and Quebec.

It was in this same year of 1904

that the British Admiralty requested Canada, along with other self-governing colonies, to conduct hydrographic surveys on its own coasts. The Canadian Hydrographic Survey, whose earliest work had been on the Great Lakes in 1883, was recognized by the appointment of the first Chief Hydrographic Surveyor. The accurate charts produced by this service have been developed, particularly further north, far in advance of any accurate land surveys. Consequently, perhaps more in a geographical than in a topographical sense, they have been an important contribution to the complete mapping of the Dominion.

THEODOLITE STATION SET FOR A VERY LONG BACKSIGHT, CENTERED BETWEEN THE TWO MARKERS

The Geodetic Survey was established in 1905 and commenced the much-needed work of extending precise horizontal and vertical control over the country. The high standard and the method of this work have been the same as those of the U.S. Coast and Geodetic Survey.

In 1906 the Geological Survey adopted the use of the plane table for mapping surveys, and in 1908 a topographical division was instituted, staffed by topographers as distinguished from geologists.

Terrain of the Province of British Columbia is largely of a mountainous nature interspaced with fertile valleys. Consequently, for purposes of development and administration, the value of the topographic map is at a maximum. In 1915 this province commenced work on phototopography with its own organization and is today the only province that maintains a sizable unit purely for mapping work.

THE DEVELOPMENT OF PHOTOGRAPHIC MAPPING

During the war, 1914–1918, tremendous strides were made in developing the airplane, and photographs were taken from the air for military use. The airplane and the air camera were to revolutionize the art of topographic mapping.

In Europe with its dense population, the boundaries of land holdings are usually well marked by roads, fences, hedges, drainage ditches, and the like. Since the need was for very accurate maps with a large scale and small contour interval, aerial mappers there went in for vertical photographs, the use of glass instead of film, and very complicated and expensive machines for plotting the photographs. At the outset, topographers in the United States were cold towards aerial mapping and when they did pay attention to it were inclined at first to experiment with plotting machines developed in Europe.

In Canada there were two main reasons which led to pioneering in this mapping method. First, many activities, and particularly prospecting for precious metals, were drawing men far afield into the hinterlands beyond the railways, and there was a strong demand for accurate maps which could not be met. Owing to the difficulties of ground transportation and the blindfolding effect of the bush on surveyors on the ground, the cost of mapping these undeveloped areas was prohibitive. Second, there were a considerable number of surveyors trained in the use of the survey camera and familiar with its long-range and other attributes. They knew what this camera could do when set up high in the air on a mountain peak, and they recognized the potentialities of setting it up on a moving platform and then flying it through the air over the vast areas which hitherto had been inaccessible except at prohibitive expense.

EARLY TYPE OF FLYING BOAT USED BY R.C.A.F. FOR AIR PHOTOGRAPHY

This new development, which, in the history of Canadian mapping, proved to be the factor which made possible the mapping of the hinterlands, was taken up by the Topographical Survey Branch. This orginated as the Dominion Land Surveys office and had introduced the ground phototopographic survey as previously described. Much credit is due to the old Air Board of Canada for fostering the work in its early stages. Continuously up to the outbreak of war, towards the close of 1939, the actual flying and photographing were carried out by the Royal Canadian Air Force.

In 1921, an initial area of 280 sq miles was photographed, and from 1924 on, something in the neighborhood of 50,000 sq miles were photographed each year. Both the oblique and the vertical methods were used, the former more commonly. Much of the area covered was far beyond the limits of geodetic control or, indeed, any accurate ground control.

Ground control, which of course is a necessity for plotting air photographs, was provided by astronomic observation. Observers with the lightest suitable instrumental equipment were transported by aircraft. One of these instruments, the British Admiralty pattern astrolabe, was used experimentally and a special light pattern was finally found which was most suitable for this work.

No paper on the subject under discussion would be complete without reference to the National Topographic Map Series established by the Topographical Survey Branch in 1924. This series is based on a modern conformal projection which suits the extent of Canada's domain. The paper sheets are of standard size, 24 by 30 in. The scales used are 1, 2, 4, 8, and 16 miles to the inch. Conventional signs and style are similar to the

TRANSPORTATION BY CANOES IN THE FALL AFTER FIRST SNOW HAS FALLEN

British Ordnance Survey maps, and the index, showing where each sheet will fit in, covers the whole of Canada.

To anyone who has given thought to the problem of mapping a vast continental area by an economical and organized procedure, it is hardly necessary to explain the many benefits arising from a basic system for map sheets covering the whole country. Nor is it necessary to explain the convenience and value of such a system to the great multitude of civilian map users. They would otherwise be obliged, when in need of maps covering certain districts, to study a number of complicated catalogues or indexes. Even when the maps were located, a lot of difficulty would be experienced in using them because they would be at different scales, drawn to different standards, and of different sizes.

THE BASIC MAP—DIFFICULTIES AND ADVANTAGES

Perhaps some people do not realize why it is not always easy to adhere to an organized system of base maps. In Canada the reason has been this. The development of the country has never been the same as the orderly and businesslike development of a valuable estate. No generation has ever acted on the basis of putting an administrative fence around the districts within economical reach of the railways and highways and then said, "We will develop these areas carefully and economically and then later on another generation can fence in a further zone and develop that carefully and properly."

On the contrary, it has always been a free-for-all development extending anywhere that pioneers and prospectors chose to go in searching for valuable natural resources. These natural resources, for example minerals, naturally do not occur according to any geometric pattern but in widely separated areas of all shapes and sizes. Then the demand comes for a map, and it is easy to see that with meager financial appropriations the strong tendency, if not necessity, is to lay down the map boundaries in any direction, adopt a special scale to meet the particular circumstances, and do all things to meet the exigency in the simplest and cheapest way. The inevitable result is, as time goes on, that the maps are produced with many variations, gaps, and overlaps—a very unsatisfactory situation.

The production of the National Topographic Series, the thing that every modern and progressive country needs, is dependent upon a set of accurate base maps. This point is regarded as of fundamental importance and is worthy of explanation.

We start off with an organized system of map sheets, each with its position on the ground predetermined so that when the sheets are completed there will be no gaps and no overlaps, and the scale and design of all the sheets will be the same. The accurate base topographic map is then made, showing all natural features and also features introduced by man if there are any. Suppose that the next year a forestry investigation is initiated. The same base map is used but the colors and conventional signs are added to illustrate the forestry data.

Perhaps the following year a geological survey is undertaken. Again recourse is had to the same base map, which with the addition of new colors and conventional signs, serves effectively to show the geologic features. And so with other studies and investigations which may be made from time to time—the new information is always shown on the same base map. All these sheets are conveniently filed away in the same drawer or other container, because they are all the same size. As time goes on the data become more complete. At any time the drawer may be opened, and all the information regarding that particular area is at hand. And if the forest area or the geological structure extends off the sheet, the next drawer is opened and there is the rest of the needed information.

Mark the advantage for a country like Canada with so much ground to cover, and so little money to do it with. It is economical, as the base map serves all purposes—those of the forester, the geologist, and so forth. In time of war, when the nation may be in peril of invasion, and maps or air charts are needed in a hurry, it is no exaggeration to say that an accurate base map is an absolute necessity.

The need for good topographical maps is not peculiar to Canada—it is universal. An excellent statement of the case, which the writer has used before but which will bear repeating, is from an old report of the then Royal Survey Department of Siam: "Not only is Science in general benefited, but every branch of the industrial and commercial development of a country is advanced, if good topographical maps of the area of operations are available. The general administration in all its branches, the location of railways and highways, the planning of schemes for water supply, for irrigation, and drainage projects, the installation of electric transmission lines, even the location of the boundaries of reservations and holdings, are all dependent on the supply of good topographical maps. Therefore, in order to mobilize all the available resources of this country and to enable them to be exploited to best advantage, it is expedient that all the territory within its borders should be triangulated and topographically surveyed at the earliest possible date."

STRIP MAPS PRODUCED

When in recent years the need arose for air charts in addition to ground maps, a start was made with a few strip charts of commercial routes. It was obvious from the first, because of the great ability of the airplane to cover distances, that the eventual requirement would be for area charts and many of them. There was a strong demand for an entirely new series of air charts designed exclusively from the air point of view. However, with appropriations insufficient for any rapid expansion of one series of base maps, it seemed impossible to undertake a new and separate series of air charts.

This need for economy, which it may be said again often leads to good results, was met by extending the policy of one base map to meet all requirements. The base ground map at the eight-mile scale was revamped in certain ways and a special red overprint was used to show all necessary air information. In actual service, as air navigation charts, the sheets have been found satisfactory. When war was declared in 1939, the first air charts covering the route of the Trans-Canada Airway were just about complete.

Army Camp Water Supply Systems

Conditions Which Influence Design Principles and Character of Service

By JAMES GIRAND, ASSOC. M. AM. SOC. C.E.

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BEFORE Pearl Harbor, when the main emphasis was on the morale of troops, the water supply standards for cantonments were equal to, if not better than, those of the most progressive cities. Now, however, other factors govern, such as material and labor shortages, prevailing weather, and type of cantonment. To illustrate the design principles followed in these water supply installations, Mr. Girand describes several typical systems in various parts of the country. His paper was originally presented before the Arizona Section of the Society.

THE Army program of cantonment construction has provided a challenging field for the engineer. Here was an opportunity to build complete water supply systems equivalent to those required by medium-sized cities. Plans could be drawn for theoretically perfect systems without having to fit a mass of patchwork left from previous construction. It was the ideal opportunity—and responsibility—for the engineer to demonstrate his ability.

Before Pearl Harbor, when morale was a primary objective of the army, cantonments and their water supply systems were constructed to standards equal to, if not higher than, those prevailing in the better cities. The water requirements for mobilization-type cantonments were unusually high, from 100 to 150 gal per capita per day. Fire protection met the standards of the Underwriters' Laboratories for cities of comparable size.

Since Pearl Harbor, as the labor and material shortage became acute and the emphasis in the army shifted from morale to fighting, the standard of cantonment construction has been reduced constantly. The first step was the abandonment of the "mobilization-type" cantonment in favor of the "theater-of-operations" type. For the latter type, the buildings are the cheapest possible construction, consisting only of light wood frames with single exterior wall sheathing covered with tar paper. In these camps no water is provided for the individual barracks. Toilet and bathing facilities are furnished in large community bathhouses centrally located in the battalion areas.

Water requirements of the theater-of-operations camps are somewhat lower than those for the mobilization type—about 70 gal per capita per day. Because of the inconvenience of central bathhouses, they definitely lower the water demand.

The latest development in cantonments has been the "field camp." This is another step in reducing the standards of construction and providing absolutely minimum facilities. The typical field camp consists only of tents without floors and the least possible building construction. Dry-pit latrines are used in lieu of water-borne sewage. Water is furnished only for the mess halls and bathhouses, which are located along a single distribution main.

Water requirements for these camps, owing to the decreased facilities available, should be substantially less than those for the theater-of-operations type. The camps are being designed for 50 gal per capita per day. It is doubtful whether a smaller use can be expected.

The trend in airport design has followed the same pattern as the cantonments. From the high standards of mobilization-type construction, the criteria have been reduced constantly to the current dispersed-type airports using theater-of-operations buildings.

A few general comments on the consumption of water in army cantonments might be of interest. It is our observation that this consumption depends on the facilities available, the weather, and the type of occupying troops. The design directives emanating from Washington presuppose that the consumption can be regulated by military authority and will be the same whether the camp is located in Maine or the California Desert. It is our experience that military control of water consumption is entirely ineffective. In one case under personal observation, there had been a serious accident in a pumping station which shut off the water supply for a week. The camp was forced to rely on stored water during this period. Realizing the gravity of the situation, both the Post Commander and the Commanding General issued the most stringent orders to curtail the consumption of water. Under this strict control, the consumption was only reduced from 1,000,000 to 700,000 gal per day! It is apparent that under routine operation of the water system, when no unusual conditions exist,

INSTALLATION OF AN ARMY CAMP WATER SUPPLY MAIN
Concrete Pressure Pipe Used in This Installation

GROUND STORAGE FURNISHED BY TWO 4-MILLION-GAL RESERVOIRS

it would be quite difficult to control the water consumption by military direction.

It was also interesting to note the large water consumption in these army cantonments. The use of water has long been recognized as an index of the standard of living of a community. Many of these soldiers came from the blighted districts of our cities where the consumption of water does not exceed 20 to 30 gal per capita per day. However, when they are housed in modern buildings with adequate facilities, their consumption of water rises to 100 or 150 gal per day.

Just as the army mess halls have added many pounds to the weight of the average soldier, so has the army raised the standard of personal living and cleanliness. It is reported that even in some of the field camps where bathing facilities are very primitive, at least 80% of the men bathe every day.

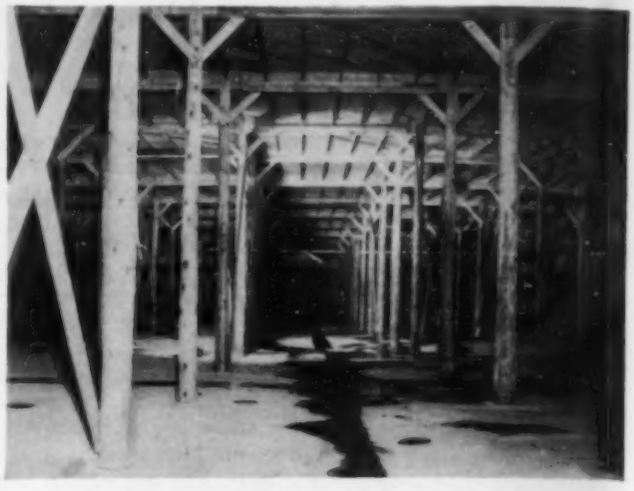
Engineering design of water systems for army camps follows the general principles of municipal work. While the criteria of water consumption, rates of flow, and fire protection, vary somewhat from municipal experience, no particular innovations along these lines have been developed.

PROBLEMS CHALLENGE INGENUITY OF ENGINEERS

These army camps are being designed for a life of five to ten years. This design directive, coupled with the acute shortage of critical materials, opens an entirely new field, challenging to the ingenuity of the engineer. Old concepts of building for permanence must be abandoned and new materials and designs adopted to fit present conditions. Steel pipe, in light gages, dipped and wrapped, supplants standard weight, at a substantial saving of steel. Wood has been extensively used for elevated water tanks. Non-critical substitutes are constantly being sought.

Storage is one of the greatest problems. Where water is obtained from wells it is obvious that the cheapest storage is in the natural underground water table. Where the terrain is suitable, surface storage reservoirs on high ground near camp are ideal. Such reservoirs, constructed of earth fills, concrete-lined, with light wood roofs, cost from 1 to 2 cents per gal. Where such low cost can be obtained, it frequently becomes economical to use increased storage in lieu of standby pumping equipment. Elevated steel tanks were constructed for about 10 cents per gal, but these have been completely banned. Elevated wood tanks cost from 25 to 30 cents per gal. This extremely high cost makes the use of tanks so expensive that some alternative method of obtaining the desired results must be found. The general rule in such cases is to place greater reliance on pumping stations and less dependence on storage.

Building services require separate studies. The successful operation of the system depends greatly on the proper sizing of these connections. In camps using water closets with flush valves, it is imperative that the pressure on the valve under the worst possible loading condi-



INTERIOR OF A 4-MILLION-GAL RESERVOIR

tions be maintained at not less than 5 lb; otherwise the valve will not close. If a sufficient number of these valves remain open, the entire water system may be drained dry. This has occurred in some instances. On the other hand, in the field camps where the most critical use of water is in bathhouses, it becomes necessary to impose some restrictions which will prevent the system from being drained by excessive use. By properly sizing the service, it is possible to limit the flow to any bathhouse to whatever rate the system is designed to carry.

A schematic diagram of the water system in a mobilization-type cantonment is shown in Fig. 1. Among the unusual engineering problems encountered at this site were the difficulty of obtaining water from the irregular and isolated gravel beds of the river bottom; the necessity for treatment to reduce a hardness ranging from 500 to 800 ppm; the 600-ft pump lift of the booster station; and the large quantity of water required to meet the heavy demands of the camp. High-level ground storage costing about 1 cent per gal was available at this site. This resulted in a decision to use additional storage in lieu of standby pumping capacity. The total cost of this water system was about $2,000,000. Ninety days were required for the engineering plans.

THEATER-OF-OPERATIONS TYPE OF CANTONMENT

At one theater-of-operations camp, the water and sewer systems governed the site plan to an unusual degree. Because of the rolling terrain, it was necessary to place the various camp units in locations and at elevations that could be served by the utilities system.

At this site the water supply conditions were unusually favorable. An excellent supply was obtained practically within the camp area from wells arranged to pump directly into the supply mains. A combination surge chamber and centrifugal sand extractor was installed at each pump. A high-level ground storage reservoir was used. Standby pumping capacity was provided by

auxiliary gasoline engines connected to the well pumps. The estimated cost of the system was about $1,000,000. Engineering design required about six weeks.

Field-camp construction has been introduced only recently. In one such camp the availability of water governed the site plan. Only one main was used, running the length of the camp, and all the buildings requiring water were grouped along it. Fire protection was provided only along this main, and at no additional cost, except for hydrants.

At these field camps it was necessary to use elevated wood storage tanks. The high cost of these tanks resulted in a decision to depend principally upon the pumping station to meet the maximum-flow demands. Only 100,000-gal total storage was provided for one cantonment comparable in size to those previously described. The pumping station, on the other hand, has excess and standby capacity adequate to furnish all peak flows. The principal engineering problems involved in this project were the economic studies to determine the proper number and location of the pumping stations and tanks, and the size of the distribution main. By drastic lowering of standards and design criteria, the cost of the water system for such a field camp has been reduced to about $100,000. The engineering design for this job required about three weeks.

DISPERSED-TYPE AIR BASE

Dispersed-type air bases are particularly interesting in that considerable ingenuity is required for an economic solution of the problem of furnishing a small quantity of water over an extremely large area. These air bases cover an area comparable to that of the larger cantonments but house only a scattered population.

In one design of great simplicity practically all the buildings requiring water were located adjacent to one large looped main. Satisfactory water was obtainable from wells within the camp site. Also there was a suitable location for a high-elevation surface storage reservoir. The total cost of this water system was estimated at about $280,000. Some three weeks were required for the engineering design.

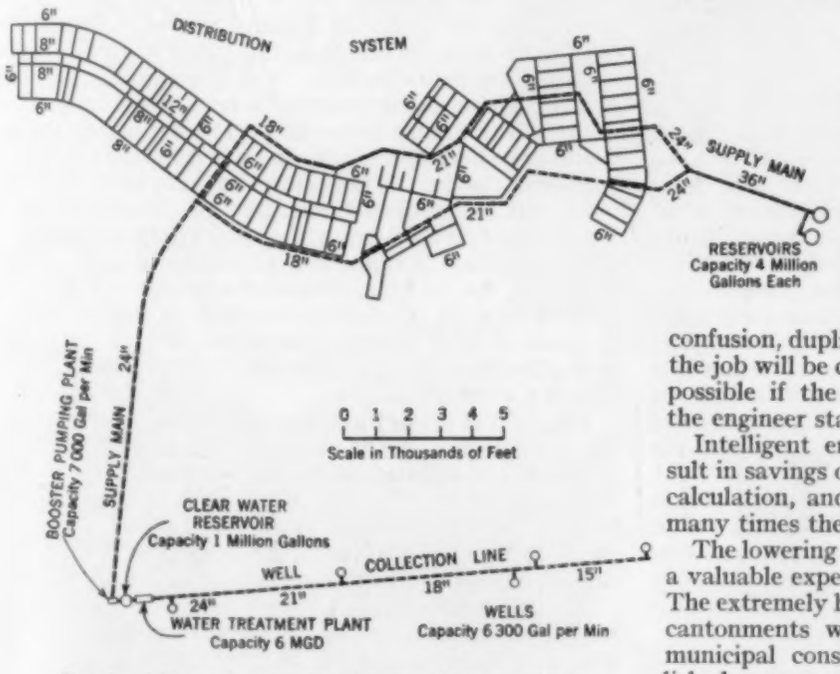
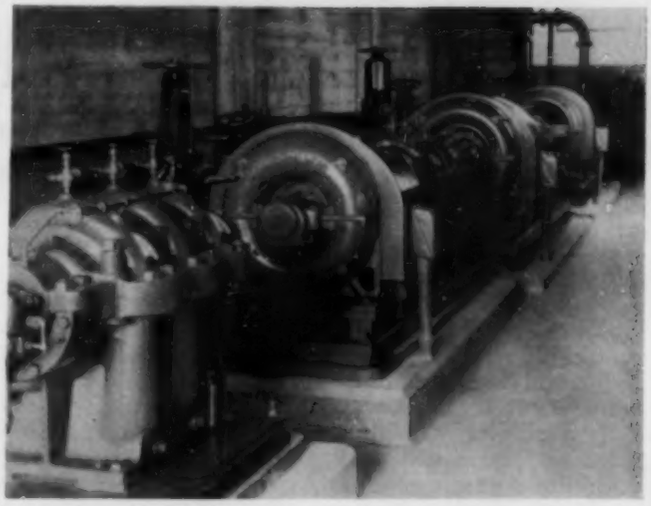

DISTRIBUTION SYSTEM
SUPPLY MAIN 36"
RESERVOIRS Capacity 4 Million Gallons Each
BOOSTER PUMPING PLANT Capacity 7 000 Gal per Min
SUPPLY MAIN
CLEAR WATER RESERVOIR Capacity 1 Million Gallons
WELL
COLLECTION LINE
WATER TREATMENT PLANT Capacity 6 MGD
WELLS Capacity 6 300 Gal per Min
0 1 2 3 4 5
Scale in Thousands of Feet

FIG. 1. WATER SYSTEM OF A TYPICAL MOBILIZATION CANTONMENT



BOOSTER PUMPING STATION AT A MOBILIZATION CANTONMENT
Two 21,000-Gal-per-Min, and Two 1,400-Gal-per-Min Units

Another dispersed-type air base presented an entirely different problem. Water service was required at many isolated points over the entire area. A high degree of fire protection was demanded throughout. This resulted in a distribution network closely resembling that of a cantonment. Water was obtainable from wells within the military reservation, but the quality varied from a minimum of 150 to a maximum of 1,000 ppm in hardness. It was decided, therefore, to develop the soft-water wells for domestic supply and, when necessary, to use the hard-water wells for standby fire protection.

The terrain of this air base was such that elevated storage tanks were necessary. Studies indicated that the lowest over-all cost of the project would be obtained by using a minimum amount of elevated storage (200,000 gal) and installing additional gasoline-driven well pumps to provide a standby service for fire protection. The estimated cost of this project was approximately $350,000; a period of some four weeks was consumed by the engineering design.

It may be of interest to draw certain general conclusions from my own experience in preparing designs for a number of camps. Thorough preparation of engineering plans and specifications expedites the construction work, even though the lack of immediate construction activity is disquieting to the authorities. When complete and proper plans are delivered to the contractor, he can organize his work on an intelligent schedule and can proceed without confusion, duplication, or uncertainty. The result is that the job will be completed earlier than would have been possible if the contractor had started his work before the engineer started his plans.

Intelligent engineering planning and design will result in savings of money and materials which are beyond calculation, and it is certain that these savings will be many times the cost of the engineering services.

The lowering of design criteria on these army jobs offers a valuable experience and point of view to the engineer. The extremely high standards of construction of the early cantonments were not justified. Similarly, in future municipal construction, design criteria can be established more accurately to fit the needs of a particular town in the light of this experience.

Salvaging a Kettle River Bridge

Timber Spans Removed from Grand Coulee Reservoir Area

By FRANK A. BANKS, ASSOC. M. AM. SOC. C.E.
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NECESSITY for salvaging all structural materials presented engineers of the Columbia Basin Project with the problem of dismantling and transporting the timbers and iron fittings of the Kettle River crossing of the Great Northern Railway. The rising of impounded waters in the stream offered a happy solution. Floating equipment, as described by Mr. Banks, loaded the timber spans and carried them downstream to a point where they could readily be dismantled.

MANY interesting engineering methods have featured the construction of the Grand Coulee Dam. The most recent is the removal of an all-timber railroad bridge from within the boundaries of the dam's 151-mile-long reservoir by loading its two spans on barges and floating them down the swift stream into the rising lake and to the dam for dismantling.

The bridge, superseded by a new crossing a quarter of a mile downstream, was situated about three miles up the Kettle River from its confluence with the Columbia River, 112 miles above the dam, and was a link in a Great Northern branch line. Its two Howe-truss, all-timber spans—one 68 ft long, weighing 90 tons, and the other, 151 ft long, weighing 210 tons—contained about 100,000 fbm of lumber.

Bureau of Reclamation crews who successfully removed the structure in this extraordinary manner gained their experience in similarly dislodging the large Great Northern Railway bridge over the Columbia near Marcus, 113 miles upstream from the dam. Its seven spans, four of steel and three of timber, a quarter of a mile long, were floated to the project similarly, and also without mishap. This crossing, too, was replaced by a new bridge, erected five miles downstream.

The equipment used on the Kettle River dismantling consisted of the *Paul Bunyan*, a power barge driven by two 125-hp Diesel engines, the *Nespelem*, a tug with a 125-hp gas engine, two freight barges, and a double-decker barge to house the 14-man crew, which previously was used for the same purpose by WPA workers in clearing the reservoir.

SWIFT CURRENT SUCCESSFULLY COMBATED

The largest span was loaded longitudinally on a 495-ton barge, 40 by 124 by 6 ft. Because of the swiftness of the stream, estimated to be flowing 6 to 7 miles an hour, it was difficult to move the vessel sideways upstream, as required, into position under the truss. As the two power boats pushed, with their propellers turning at maximum speed, workmen simultaneously operated winches and 3-ton rachet lever hoists to pull the barge under the truss.

The swift water created another problem. In striking the barge, the current forced the upstream side into the water, and caused the downstream side to be tilted upward. To remedy this, five-ton journal jacks were placed between the high side of the barge and the bridge to force the vessel into a horizontal position.

With the barge properly spotted and leveled, pumps were started, and the hull partially filled with water, lowering it about 2 ft. Twelve-point blocking, consisting of cribs 6 ft square, of 12 by 12-in. timbers, was then arranged. The last step in loading was to unwater the barge and lift the span from its timber piers.

The *Nespelem*, by means of a 40-ft line, towed the load down the river, while the *Paul Bunyan*, through a cable of similar length, retarded the movement, when necessary, and assisted with the maneuvering. Where the Kettle flows into the Columbia, it passes, for a distance of about 200 yd, through a narrow gorge about 95 ft wide and marked with menacing boulders. At this point, the *Paul Bunyan* was tied to the bank and winch-lines were used to slack the span-carrying barge slowly down the stream into the main river.

The smaller span was floated and transported downstream in similar fashion, being placed diagonally on a barge of 400-ton capacity, 80 by 40 by 7 ft 10 in. Sixpoint blocking was used. Each block was a crib 6-ft square made of 12 by 12-in. timbers. A small trestle and three all-timber piers, dislodged with explosive, were also loaded and moved to the dam.

RISING WATERS REDUCED BRIDGE CLEARANCE

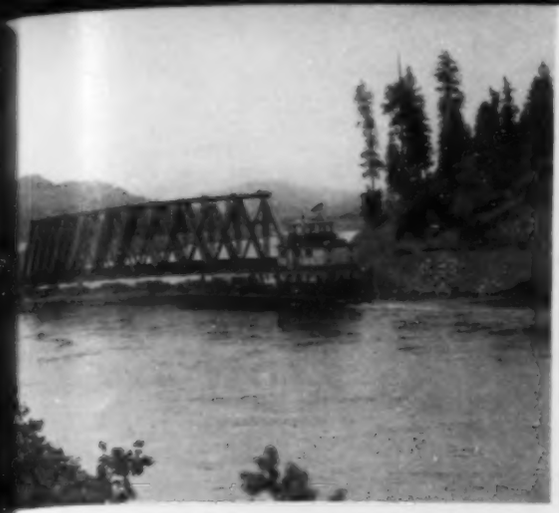
Proper timing was an important phase of the undertaking. To transport the strange shipment through restricted passages of the narrow gorge, it was necessary, first, to wait for the growing Grand Coulee Dam reservoir to back into and deepen the confined areas, and, secondly, to move the spans quickly, once this was possible, before the rising waters impaired clearance under the new railroad crossing downstream. When the old bridge passed under the new, the clearance was found to be only 8 to 10 in. Four other bridges were passed under with a greater margin.

Bureau records show that two days were required to transport the working flotilla from the dam to the bridge, one day to do the loading, two days to make the return trip with the bridge sections, and four days to dismantle them near the dam. The dismantling operation was considered highly successful from the standpoint of savings in both man-hours and cost. Ordinarily the job would have necessitated moving a derrick 150 miles overland from the dam to the bridge, to drive piling for falsework and to handle timbers, and the transportation of the dismantled sections to the dam an equal distance.

With lumber an important war material, now difficult to obtain, the salvage value of the bridge is high. The Bureau recently purchased a sawmill to cut up the timbers and those of several other spans, and also green logs to be floated down the reservoir, from the forests along its shore, to the dam.

Removal of bridges and construction of new spans was but a small part of the program of relocating highways and railroads situated within the reservoir. The Bureau was required to construct 90.49 miles of state primary highway, 89.33 miles of secondary roads, 27 miles of railway, three major bridges, six smaller bridges, and numerous other structures.

The reservoir extends northward from the dam to the Canadian border. It has an average width of 4,000 ft, and directly upstream from the dam it is more than 400 ft deep. It is one of the largest man-made lakes in the world.



THE "PAUL BUNYAN" MANEUVERING THE BARGE INTO PLACE BENEATH THE 151-FT SPAN OF THE KETTLE RIVER BRIDGE

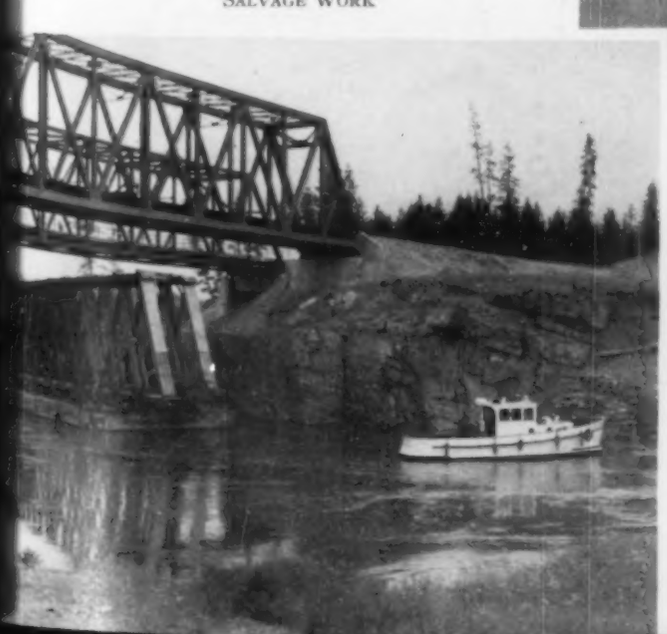
A 400-TON BARGE PREPARED TO RECEIVE THE 68-FT SPAN

THE LONG SPAN ON ITS WAY DOWNSTREAM HAD TO PASS THROUGH THIS DIFFICULT CHANNEL

THE SHORT SPAN WAS PLACED DIAGONALLY ACROSS THE BARGE BECAUSE OF LIMITED CLEARANCE BETWEEN PIERS

EXPERIENCE FOR THE DIFFICULT KETTLE RIVER SALVAGE JOB WAS OBTAINED IN THE REMOVAL OF THIS STEEL STRUCTURE ACROSS THE COLUMBIA

A CRITICAL CLEARANCE THAT CALLED FOR CAREFUL SCHEDULING OF THE SALVAGE WORK



PASSAGE OF THE SPAN DOWNSTREAM WAS DEPENDENT UPON WATER LEVEL IN THE RIVER

Concrete Pavements Without Steel

Designs That Have Been Adopted for State Highways, Military Access Roads, and Airports

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REGIONAL HIGHWAY ENGINEER, PORTLAND CEMENT ASSOCIATION, NEW YORK, N.Y.

WARTIME restrictions upon the use of certain materials have been directly responsible for many changes in design practice. In the case of concrete pavements, steel had previously been considered essential to rational design, but the creation of the "critical" list changed all that. Now, as Mr. Andrews explains, roadway surfaces of all classes are being constructed without a pound of steel. This paper was presented at the Joint Meeting of the Society and the Engineering Institute of Canada at Niagara Falls, Canada.

CONSTRUCTION practices, as carried on in the past by the states and other road-building agencies, have shown a wide variety of concrete pavement design, in so far as use of steel and jointing arrangements are concerned. Service records of pavement performance on these projects have helped to support the theoretical considerations which must be set up in design procedure. To determine where and in what quantities steel may be eliminated, it is desirable to analyze its function.

In general the unit distribution of military loads is such that the usual slab thicknesses required for normal heavy-duty civil use need not be exceeded. Therefore this paper is concerned chiefly with changes in other design details to meet the critical materials situation.

DISTRIBUTED REINFORCEMENT

Distributed steel in the form of bar mats or wire mesh is used to hold the faces of slabs closely together where intermediate cracks occur between joints, and thus avoid free edges and corners. The amount of distributed steel commonly used does not increase the load-carrying capacity of uncracked slabs nor does it prevent cracking. However, after cracks occur it holds them tightly closed, thus providing load transfer across irregular slab faces.

In the thickened-edge type of design it is important that load transfer be maintained where intermediate cracks occur in order that otherwise weak sections may be avoided. Where a uniform depth of slab is used, the edges at open cracks will be as strong as the exterior edges.

The infiltration of dirt and sand into cracks is minimized where they are held closely together by steel. Such progressive infiltration of incompressible foreign material is generally considered an important factor in developing high compressive stresses and ultimate "blow-ups" in existing pavements.

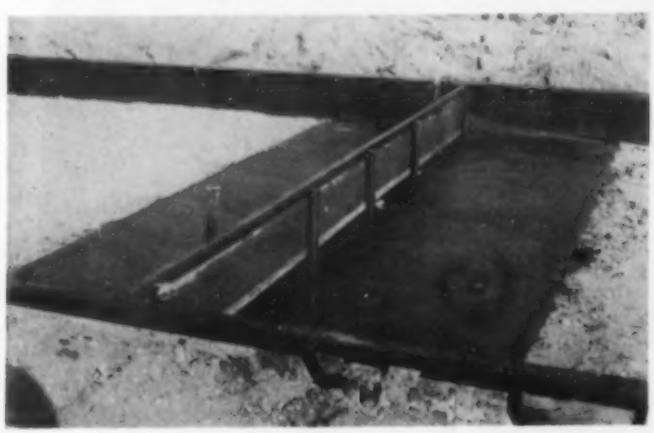
There is ample evidence from existing pavements that proper jointing will greatly reduce or practically eliminate intermediate cracking. Since the principal function of distributed steel is to insure close contact of slab faces at cracks, which may occur between joints, it is logical that the adoption of an adequate jointing design is the first and most important step in reducing or eliminating the need for such steel.

Condition surveys and experience over a period of years in many states throughout the country have established the conclusion that adequate crack control can be secured by the use of joints spaced to form the following slab lengths, depending on the kind of coarse aggregate used in the concrete:

TYPES OF COARSE AGGREGATE	SLAB LENGTH (FT)
Granite and trap rock	25
Limestone	20
Flinty limestone	20
Gravel: Calcareous	20
Siliceous	15
Less than $^3/_4$ in. size	15
Slag	15

These slab lengths can be secured most economically by a combination of expansion and intermediate contraction joints. The dummy groove is the most popular method of forming contraction joints. It provides an excellent anchorage for the joint sealing material, thus offering much better protection against infiltration of foreign materials than a similar seal on the slab surface at an ordinary crack.

Tie-bars are used principally across interior longitudinal joints to hold slab faces closely together, thereby pre-



SUBBASE SLAB AT EXPANSION JOINT PREVENTS DISLOCATION OF PAVEMENT

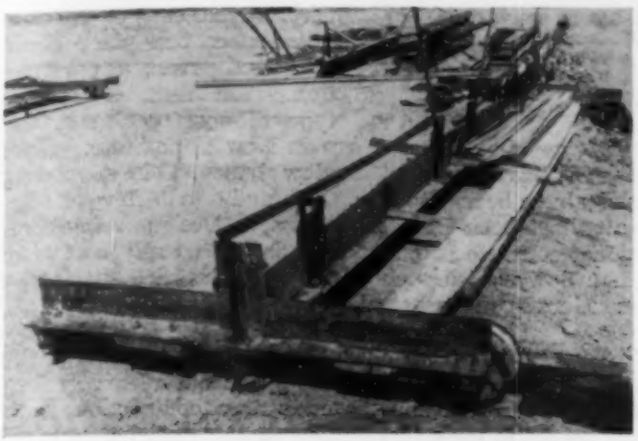
Expansion Joint Filler of Redwood in Place

CUTTING A DUMMY CONTRACTION JOINT

Tool Consists of Light-Section T-Rail with Base Cut Off

venting free edges in the interior portion and maintaining balanced structural strength between the interior of the slab and the thickened edge. Adequate load transfer, however, must be accomplished by tongue-and-groove construction or aggregate interlock below the dummy groove, depending on the type of joint detail desired.

Tie-bars are not needed where the pavement is of uniform depth, since both the interior and exterior edges have the same structural strength. However, it may be desirable to supply them under some conditions to prevent slab separation and possible vertical displacement along longitudinal joints.



MACHINE FOR CUTTING DUMMY CONTRACTION JOINTS ON A MILITARY ACCESS ROUTE
16.5 Miles of Two-Lane Road Constructed in 25 Working Days

Tie-bars will not be needed at interior longitudinal joints of thickened-edge slabs where such edges are thickened in a manner similar to the exterior edges, unless required to prevent slab separation. For two-lanes-at-a-time construction, the longitudinal dummy-joint groove should be cut to such a depth that the concrete below the groove is at least one inch less in thickness than the interior thin portion of the slab. This is essential to insure that the resulting crack will occur at the dummy joint.

For lane-at-a-time construction, it is recommended that a tongue and groove be provided at the longitudinal construction joint in order to keep adjacent slabs at the same elevation under conditions of use, although this is not required for transfer of load to maintain structural balance.

In some localities a deformed metal dividing plate with tie-bars has been used at the longitudinal joint to form a plane of weakness, to transfer load, and to tie the slabs together. This type of construction can be eliminated by substituting the designs previously described.

Slip dowels or other metal devices are installed across transverse joints for the transfer of load and to provide free longitudinal movement of slab ends at the joint. Their primary purpose is to transfer part of the wheel load from one slab to the other and in this way reduce stresses in slab ends and corners. A secondary purpose is to prevent vertical displacement of the slab ends under some subgrade and traffic conditions.

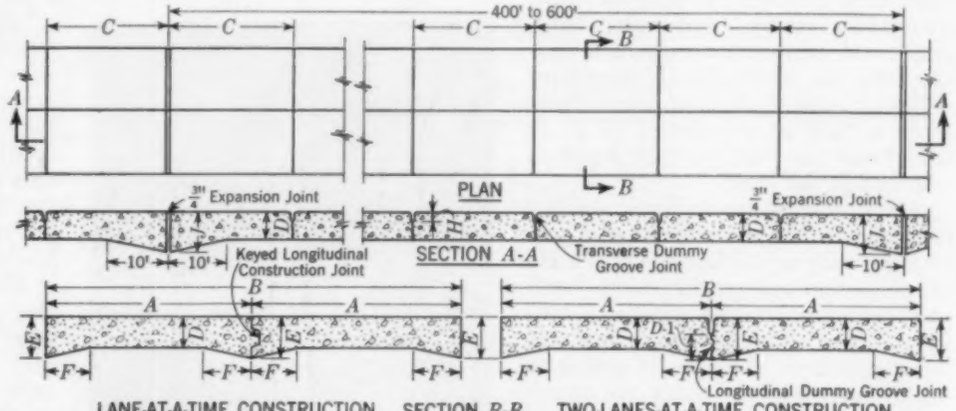
SUBGRADE PREPARATION FOR LANE-AT-A-TIME CONSTRUCTION
Dummy Contraction Joints at 15-Ft Intervals

In thickened-edge pavements, slip dowels provide a structural balance at transverse expansion joints by avoiding critical stresses from wheel loads in the thin section of the slab and at corners. The same purpose is served at transverse contraction joints where there is no aggregate interlock because of the small size of the coarse aggregate used, or where vertical butt-type construction joints are installed. The only function of slip dowels in uniform-depth pavements, except at the slab corners, is to prevent vertical displacement.

Slip dowels or similar devices are needed to transfer wheel loads at transverse expansion joints unless some other adequate means is provided to strengthen or support the slab ends. The quantity of steel required for dowels can be materially reduced by placing the expansion joints at long intervals.

THE PROBLEM OF EXPANSION JOINTS

Research data and field observations indicate that a rather limited amount of expansion space, much less than commonly used, will protect the pavement from critical compressive stresses. Also, if dummy-groove contrac-



LANE-AT-A-TIME CONSTRUCTION — SECTION *B-B* — TWO-LANES-AT-A-TIME CONSTRUCTION

TYPE OF ROAD	*A*	*B*	*C*	*D*	*E* & *J*	*F*	*H*	QUANTITIES FOR 1 MILE OF PAVEMENT	SQ YD	CU YD
Primary – Metropolitan Area	11'	22'	15' to 25'	7"	10"	2' 6"	1 3/4"		12 907	2 772.8
Primary – Rural Area	11'	22'	15' to 25'	6"	9"	2'	1 1/2"		12 907	2 367.0
Primary – Lightly Traveled	10'	20'	15' to 25'	5.5"	8"	2'	1 1/2"		11 733	1 970.5
County Trunk	9'	18'	15' to 25'	5"	7.5"	2'	1 1/4"		10 560	1 642.5

FIG. 1. TYPICAL CONCRETE PAVEMENT WITH NO STEEL
Portland Cement Association Design

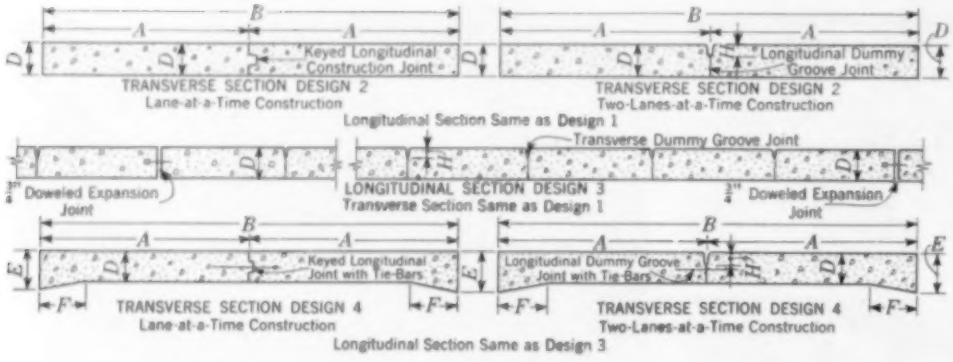


FIG. 2. PAVEMENT CROSS SECTIONS FOR VARIATIONS OF DESIGN I (FIG. 1)

tion joints are spaced to control cracking and are properly maintained to exclude infiltration of foreign material, very little expansion space is needed.

There are distinct advantages in providing only sufficient expansion space to keep compressive stresses within safe limits. Under these conditions the slab will be under compression at temperatures above that obtaining at the time of placement. Then at lower temperatures the contraction-joint opening will be at a minimum, which is important in providing load transfer at these joints. The additional compressive stress caused by longer spacing of expansion joints will actually be beneficial in reducing tensile stresses caused by warping and loads.

Factors affecting expansion space requirements are the variations from the temperature at which the pavement was placed, and the possible infiltration of inert material into cracks and joints. Field observation and theoretical analysis indicate that with normal materials, under average climatic conditions and with the contraction-joint interval recommended, $^3/_4$-in. expansion joints at 400 to 600-ft spacings will protect the pavement from critical compressive stresses. Expansion joints may be omitted entirely where conditions are particularly favorable. Dowel steel can be reduced 70 to 80% by using $^3/_4$-in. expansion joints at 400 to 600-ft intervals in place of the 120 ft required by some official regulations.

Dowels may be entirely eliminated at transverse expansion and construction joints and a structural balance may still be maintained by thickening the slab ends so that they require no support from abutting slabs. Experience and studies of performance indicate that the slab end should be thickened by a straight-line slope from the normal cross section at a point 5 to 10 ft back from the joint to such depth as required at the joint.

When dowels are to be eliminated in thickened-edge pavements, it will be necessary to thicken the slab ends at expansion and construction joints in order to maintain a structural balance. Also, slab-end thickening will be required in the case of uniform-depth pavement in order to secure the most economical slab design. Otherwise the pavement would have to be uniformly of the thickness required for structural adequacy at the free corners.

On heavy-duty pavements, and particularly where subgrade conditions are unfavorable, it may be found desirable to provide dowels or other devices to prevent vertical displacement—"stepping off" of slab ends ahead of the joint in the direction of traffic. Some trouble of this sort was experienced in several northeastern states until remedied by appropriate design.

Still another method of eliminating dowels is to support the slab ends on concrete subslabs cast in place ahead of normal pavement construction. The first use of this type of construction in this area was about 8 years ago in New York State. Since then it has been used in New Jersey. The supporting slabs have been 4 to 6 in. thick and 4 to 5 ft wide. Results have been quite satisfactory. Designs using additional concrete at the slab ends will usually cost more than dowels, but such costs may be justified at this time in order to conserve steel.

ELIMINATION OF DOWELS AT CONTRACTION JOINTS

When expansion joints are spaced at relatively long intervals and intermediate dummy contraction joints are spaced at the intervals here recommended, dowels will not be required for load transfer across the contraction joints. When the pavement is in compression, the contraction joints will be tightly closed.

Where contraction joints are spaced so as to prevent intermediate cracks from occurring, the amount of contraction of each of the relatively short slabs will be very small and not sufficient to open the dummy contraction joints and interfere with aggregate interlock below the dummy groove and transfer of load across the joint. Observations and studies of joint performance in many states throughout the country show that entirely satisfactory results may be expected with undoweled dummy contraction joints.

The design principles that have been outlined are now developing into accepted practice throughout the country. A typical design using no steel, as published by the Portland Cement Association, is shown in Fig. 1. In Fig. 2 are shown variations of this design to be used when conditions warrant.

TYPICAL DUMMY CONTRACTION JOINT AFTER FILLING WITH MASTIC MATERIAL
Note Crack Below Joint

Most of the highway departments in the northeastern states have adopted plain concrete pavement designs, with dummy contraction joints at an average of about 20 ft apart. Spacing of transverse expansion joints has varied. The average has been about 120 ft, but on some projects spacings up to 500 and 600 ft are being used.

The military establishments and the various aviation agencies have also adopted plain concrete pavement designs very similar to those here described. The large airport programs which have been under construction for some time, based on such designs, are showing very satisfactory results. The use of short slab lengths (15 to 20 ft) with relatively long intervals between expansion joints, has proved the merit of this crack-control design.

Engineers' Notebook

Ingenious Suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

Angle of Load to Grain for Timber Connectors

By M. S. KETCHUM, ASSOC. M. AM. SOC. C.E.

ASSISTANT PROFESSOR OF STRUCTURAL ENGINEERING, CASE SCHOOL OF APPLIED SCIENCE, CLEVELAND, OHIO

THE greatest stumbling block to the proper understanding of the structural action of timber connectors is the method of obtaining the angle of load in the connector to the grain of the wood. The joint in the timber truss sketched in Fig. 1 (*a*) represents a typical case. The vertical compression strut is placed on the inside and the chord members on the outside, with the diagonals between. The problem is to find the angle of the load to the grain for each of the contact faces of the members at this joint.

For solving problems involving forces, the universal tool is the free body diagram. This diagram shows a portion of the structure cut away from the remaining part. All the forces known or unknown are indicated. These forces must hold the free body in equilibrium. For example, the sketch of the joint in Fig. 1 (*a*) is a typical free body diagram, because the entire joint has been cut away from the other parts of the truss, and the forces shown hold the joint in equilibrium. To find the internal action in the joint, it will be necessary to take the joint apart piece by piece and show the forces that hold these pieces together.

The first member to be studied will be the vertical, for which the free body diagram is shown in Fig. 1 (*b*). The single force of 5.0 kips through the two connectors is all that is required to hold the member in equilibrium. Therefore, in the vertical, the angle of load to the grain is zero. Next, the inside face of the diagonals will be studied. The load in each chord member and diagonal is half of the total stress, and in Fig. 1 (*c*) only one chord member and one diagonal are shown. The force in the connector is $P = 2.5$ kips. The sketch clearly shows that the angle of load to the grain for this joint is 48°.

To solve for the forces on the outside face of the diagonals, the diagram sketched in Fig. 1 (*d*) is used. The only force necessary to hold the vertical and diagonal in equilibrium is a 5.5-kip force, horizontal. The angle of load to the grain is 42°.

The final free body diagram, Fig. 1 (*e*) is a sketch of one of the chord members. The angle of load to the grain is zero. The only member in this truss for which there is an angle of load to the grain is the diagonal. It is difficult to visualize the action of ring connectors clearly without the aid of free body diagrams, and they should be drawn whenever there is any uncertainty about the structural action.

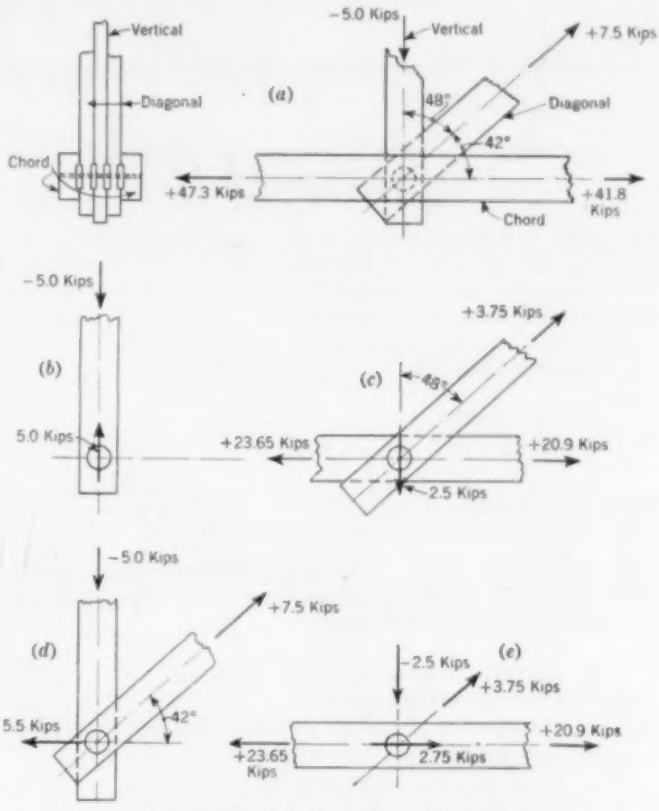


FIG. 1. TYPICAL FREE BODY DIAGRAMS

Stresses and Displacements from Loads Over Rectangular Areas

By HAMILTON GRAY, JUN. AM. SOC. C.E.

ASSISTANT PROFESSOR OF CIVIL ENGINEERING, NEW YORK UNIVERSITY, NEW YORK, N.Y.

DISTRIBUTION of stresses under a rectangular-shaped load has long been a problem which has had considerable practical application in foundation engineering. The fundamental solution of Boussinesq for the stresses and strains induced in a semi-infinite isotropic and homogeneous elastic mass, by a concentrated load applied normally to its plane surface, is extended by direct integration to cover various types of distributed surface loads. Other methods have been employed, but the method of integration is most readily understood, and is relatively easy to apply.

A case that has not to the author's knowledge been previously published is that of a planar variation of stress over a rectangular area. Any irregular surface load distribution can be analyzed by arithmetical summation utilizing Boussinesq's point load formulas, but

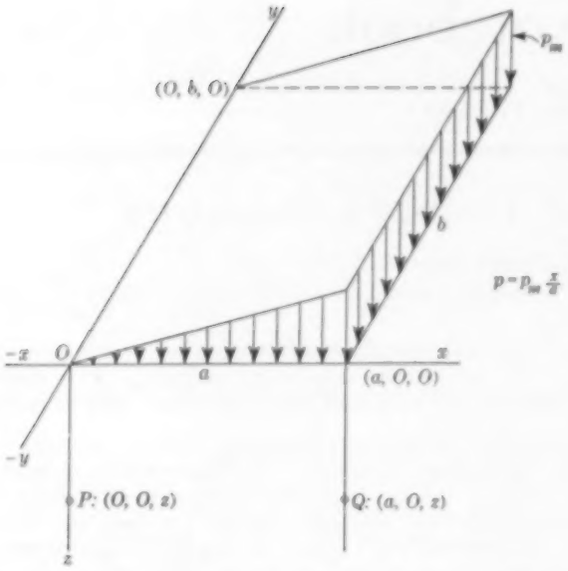


FIG. 1. THREE-DIMENSIONAL ILLUSTRATION OF NON-UNIFORM DISTRIBUTION OF SURFACE LOAD

the writer has found that in many cases the development and use of an explicit formula require less time and effort than the tedious subdivision of the loaded area and computation otherwise involved.

The situation is illustrated in Fig. 1, and the results were secured by evaluating the integrals

$$\sigma_z = \frac{3z^3}{2\pi}\int_A\int\frac{pdA}{R^5},$$

$$\delta = \frac{1+\mu}{2\pi E}\left[z^2\int_A\int\frac{pdA}{R^3} + 2(1-\mu)\int_A\int\frac{pdA}{R}\right] \quad ...(1)$$

over the loaded area. The figure illustrates the significance of most of the symbols employed. In addition, the following notation is used:

σ_z = normal stress on horizontal planes
δ = vertical displacement
E = modulus of elasticity of elastic body
μ = Poisson's ratio of elastic body
$R = \sqrt{x^2 + y^2 + z^2}$ for point P
$R = \sqrt{(a-x)^2 + y^2 + z^2}$ for point Q
$A = ab$

$$R_a^2 = a^2 + z^2$$
$$R_b^2 = b^2 + z^2$$
$$R_D^2 = a^2 + b^2 + z^2$$

The results of the evaluation of the first integral are:

$$\text{At } P,\ \sigma_z = \frac{p_m}{2\pi}\frac{b}{a}\left[\frac{z}{R_b} - \frac{z^3}{R_D R_a^2}\right]$$

$$\text{At } Q,\ \sigma_z' = \frac{p_m}{2\pi}\frac{b}{a}\left[\frac{zR_D}{R_b^2} - \frac{z}{R_b} + \frac{a}{b}\sin^{-1}\frac{ab}{\sqrt{a^2b^2 + R_D^2z^2}}\right]$$

The sum, $\sigma_z + \sigma_z' = \sigma_z''$ gives the stress under the corner of a uniformly loaded rectangular area:

$$\sigma_z'' = \frac{p}{2\pi}\left[\frac{abz}{R_D}\frac{z^2 + R_D^2}{z^2R_D^2 + a^2b^2} + \sin^{-1}\frac{ab}{\sqrt{a^2b^2 + R_D^2z^2}}\right] \quad ...(2)$$

Figure 2 shows curves giving the relation between σ_z/p_m, σ_z'/p_m, σ_z''/p_m, and z/a for various ratios of b/a.

When b approaches infinity, the results become

$$\sigma_z = \frac{p_m}{2\pi}\frac{az}{R_a^2} \qquad \sigma_z' = \frac{p_m}{2\pi}\sin^{-1}\frac{a}{R_a}$$

which is in agreement with the formulas of Carothers for the case of plane strain.

For settlements, we have:

$$\text{At } P,\ \delta = \frac{1+\mu}{2\pi E}\frac{p_m}{a}\left[(1-\mu)b(R_D - R_b) + \mu z^2\sinh^{-1}\frac{b}{z} + (a^2 - \mu a^2 - \mu z^2)\sinh^{-1}\frac{b}{R_a}\right]$$

$$\text{At } Q,\ \delta = \frac{1+\mu}{2\pi E}\frac{p_m}{a}\left[(1-\mu)b(R_b - R_D) - \mu z^2\sinh^{-1}\frac{b}{z} + (a^2 - \mu a^2 + \mu z^2)\sinh^{-1}\frac{b}{R_a} + 2(1-\mu)\times ab\sinh^{-1}\frac{a}{R_b} + (2\mu - 1)az\sin^{-1}\frac{ab}{\sqrt{a^2b^2 + R_D^2z^2}}\right]$$

Curves showing the variation of δ/δ_o (where δ_o denotes the subsidence of the surface) with z/a may also be plotted. In this case the value of μ must be taken into account.

It is interesting to note that the stresses do not vary appreciably near the surface when the ratio b/a is increased from 2 to infinity. Computation of values necessary for plotting similar curves for other values of

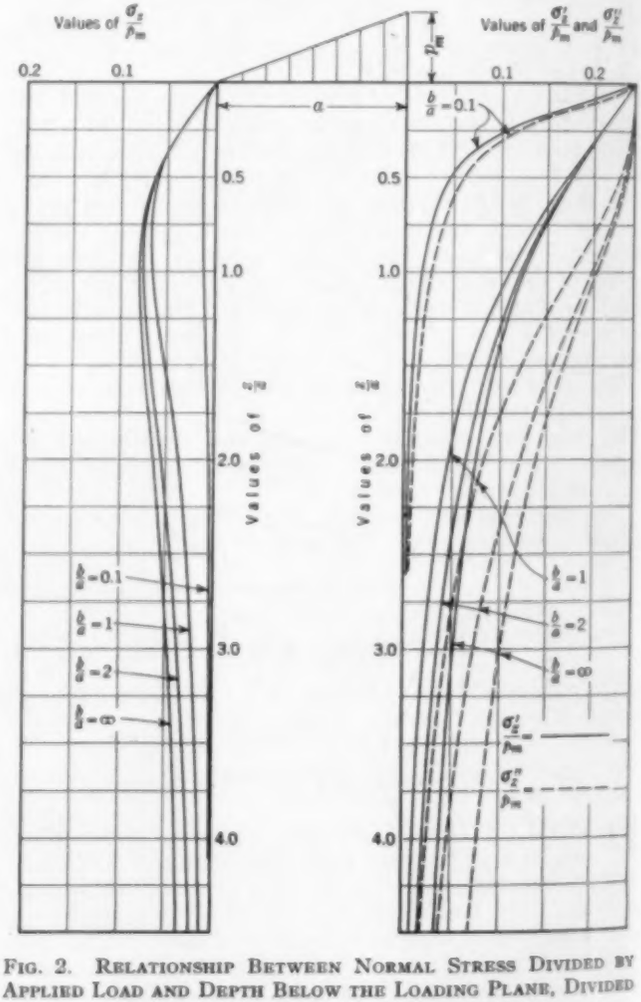


FIG. 2. RELATIONSHIP BETWEEN NORMAL STRESS DIVIDED BY APPLIED LOAD AND DEPTH BELOW THE LOADING PLANE, DIVIDED BY ONE DIMENSION OF THE LOADED AREA

b/a is easy, and families of these curves furnish a ready means of estimating the pressures induced by similar loadings. In conclusion it should be noted that by properly combining the foregoing solutions it is possible to determine the stresses due to rather complicated discontinuous surface loads. It must also be realized that in actual practice the type of pressure exerted between the earth and the substructure is in all probability quite unlike the distribution assumed.

In the first place, shearing stresses are unavoidably introduced, and these are certain to influence the actual value of σ_z as well as other normal stresses. In the second place, the flexural stiffness of the substructure results in displacements and stresses other than those computed on the basis of assumed distributions of normal contact pressures. Consequently the use of formulas similar to the foregoing will furnish results which must necessarily be merely estimates of what might occur, and not exact analyses of certainties.

In some instances one may use two extremes to define the probable range of actual stresses or subsidences. For example, when dealing with building loads that are relatively unvarying over the area occupied, one may consider (*a*) that the corresponding foundation pressure is uniformly distributed over the area, thus neglecting the stiffness of the foundation and superstructure, and (*b*) that the foundation and superstructure are so rigid that the foundation undergoes a uniform subsidence while the pressures reacting thereon are not uniform. (An exact solution for this case has never come to the writer's attention.) The actual conditions logically lie between these two extremes and only a guess (or "judgment" if we are jealous of professional status) can be applied in most circumstances to secure a closer estimate.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Regrading of Society Membership Proposed

According to the long-standing policy of CIVIL ENGINEERING, *any criticism of Society management is eligible for publication, provided it is accompanied by appropriate rejoinder from the official or committee of the Society most closely concerned. On this basis the two following letters are printed in parallel.*

TO THE EDITOR: Some twenty years ago when registration was a burning question and the writer was serving on the Board of Direction of the Society, he spoke at a meeting in favor of registration and stated that young engineers need recognition, research, and registration.

Recently Dean C. R. Young, M. Am. Soc. C.E., pointed out that registration is not in itself sufficient, but our Board of Direction fails to recognize that admission to corporate membership in the Society is our first acknowledgment that a young man is an engineer.

In the other professions in New York State, lawyers may be recognized by the courts when they are 21 years old and have passed the state bar examinations. Doctors may practice when they have completed specified studies, are 21 years of age, and have been granted a state license. Ministers may preach as soon as they are approved by their official boards. But civil engineers must be 27 years of age (which in practice means that they are nearly 30) before they are recognized by our august body, which lays emphasis on old age rather than achievement.

History tells us that George Washington was commissioned a public surveyor at 16 and at 21 departed on a delicate government mission to warn the French to keep out of the Ohio country. According to the Encyclopedia Americana, Admiral Farragut commanded a battleship and fought a bloody engagement with the British at the ripe age of 14. Andrew Carnegie was superintendent of military roads and telegraphs at the age of 21.

I therefore propose a regrading of the membership which would drop the anomalous title of Associate Member and establish a Junior Corporate Membership, as follows:

GRADING PROPOSED	AGE	DUES
Member, Junior Grade	21–30	$15
Member, Senior Grade	25 Min.	20
Master Member	35 Min.	50

It will be noted that the minimum age of 25 has been adopted by a number of state registration boards.

The Board of Direction should arrange for the changes in the Constitution and make rules for adjustments of present membership to the new grades. I am sure the Board of Direction will welcome letters from the membership commenting on the proposed change.

LEWIS D. RIGHTS, M. Am. Soc. C.E.

Roselle, N.J.

"TO THE EDITOR: As chairman of the Membership Qualifications Committee, the writer has been asked to comment on Mr. Lewis D. Rights' letter.

We have quite recently voted on a general overhauling of membership titles, and the Society has indicated a preference for the existing system. Time is giving them a traditional value, and they have been honored in acceptance by our most distinguished members. I believe there will be less and less disposition to tinker with them. The term "Master Member" corresponds to "master" plumber or barber, and indicates the employing tradesman, rather than any special qualification. The change in minimum ages is not important, that for the second membership grade being lowered just two years, from 27 to 25. Thus the only really fundamental step advocated by Mr. Rights is to give Juniors the privilege of voting. The arguments on this question will relate to two points:

1. Have Juniors adequate background in professional and Society matters to make their ballots effective?
2. Do they really seek the privilege of voting?

The corporate member of our Society has an opportunity to express himself in the election of officers and directors, and from time to time on constitutional changes, submitted in due form. In both cases, intelligent exercise of the suffrage privilege requires acquaintance among our members and knowledge of Society problems. This introduces a time factor, and demands attendance at meetings and reading of our publications. The new member, even now, stepping into the Society does not have this background. Fortunately the majority enter through the Junior grade, and the period for seasoning and experience in Society affairs does not appear too long. Juniors are being given special encouragement by the Sections, and do now actively participate in the technical

sessions and social contacts of the Sections as well as their own Junior forums.

If the Juniors are generally demanding the right to vote, they certainly value this privilege more than do most of our corporate members. The percentage of those eligible to vote who cast ballots in the annual elections varies from 24% to 39%. This may mean indifference, or it may mean satisfaction with present policies and management. The salvation of democratic institutions is the power of the voter to upset conditions when they are seriously wrong.

Before the Board of Direction initiates any formal consideration of changes, I am sure it will want to know that a substantial section of the membership supports the proposed plan.

JOHN W. CUNNINGHAM, M. Am. Soc. C.E.
Chairman of the Committee on Membership Qualifications

Portland, Ore.

Alcan Highway and Peace River Crossing

TO THE EDITOR: Relative to General Sturdevant's paper on the Alcan Highway, in the March issue, it is of interest that about 1930 the late Col. William Mitchell discussed with the writer his idea of a chain of air fields and a highway to Alaska from Edmonton, which was based on information he obtained from Klondike miners who came in by that route while he was with the Signal Corps in Alaska.

The Alcan Highway as built follows Colonel Mitchell's plan substantially, except that it starts from Dawson Creek, the railhead on the south side of the Peace River, instead of from Hines Creek, the railhead of the branch of the Northern Alberta Railways on the north side of the river, as planned by Mitchell. This starting from Dawson Creek makes it necessary to cross the Peace River at Fort St. John, and this crossing is one of the major engineering difficulties of the Alcan Highway.

The Peace River is wide, and is subject to ice troubles and to floods of 300,000 cu ft per sec. Mr. MacDonald, in his paper in the April issue, states that the crossing will be by an 1,800-ft suspension bridge. But this will require much time and critical materials. Furthermore, the river banks are from 800 to 900 ft high at this point, and experience in northern Alberta is that such approach grades and cut-bank locations usually require heavy maintenance.

It might be well to consider building a highway from the railhead on the north side of the river, as planned by Mitchell, to connect with the highway already built north from Fort St. John. A pack trail has been operated over this route for many years.

W. L. WATERS, M. Am. Soc. C.E.
Consulting Engineer

New York, N.Y.

Engineers Fitted to Make Comprehensive Community Plans

TO THE EDITOR: The letter by Jacob Mark, entitled "Future of City Planning and Housing," that appeared in the April issue of CIVIL ENGINEERING was read with much interest and appreciation.

The Planning Act of the State of California makes it mandatory that "every city and every county shall adopt and establish, as herein provided, a Master Plan of said city or county and official plans based thereon. Said plans are hereby declared to be established to conserve and promote the public health, safety, and general welfare."

I know of no professional group that deals with safety as much as do the engineers; in other words, the engineer is responsible for the construction that is used by the general public. In matters of health, again the engineer is involved, in cooperation with the various health departments. In my opinion, the engineer has not been directly responsible for general welfare work. The politician and the promoter have more or less made this their issue, for their own benefit, and in most cases have received credit from the public.

Here is an opportunity for the engineer to spend some time on a comprehensive plan for the community. This plan does not have to be worked out in detail, but must be so drawn as to form a guide for the people of the community to consider. In this way, the engineer would introduce the idea and leave the work of carrying out the plan to completion to the politician and the promoter.

In order to further the interest of engineers in future planning, I would like to see a series of articles discussing planning procedure appear in CIVIL ENGINEERING each month for a period depending upon emergency conditions; then, later, reports and recommendations for future community development.

LORIN W. DEEWALL, Assoc. M. Am. Soc. C.E.
County Planning Engineer, San Diego County Planning Commission

San Diego, Calif.

Practical Courses in City Planning Needed

DEAR SIR: The letter by Jacob Mark, in the April issue (page 187), was of particular interest to me. I agree with his statement that engineers, in general, show a surprising lack of interest in city planning and housing.

Several years ago I took some lecture courses in housing and planning at the New School for Social Research in New York City. There was not even a handful of technical men in any of the classes. Most of the students were teachers or social workers. After attending these lectures I came to the conclusion that courses devised especially for engineers and architects and dealing with design problems of housing and city planning projects would be of more practical benefit.

However, I was most interested in Mr. Mark's statement that greater opportunities will come to the engineer, if he will only become interested in the subject. I have been interested in city planning and housing ever since I attended college, yet have not been successful in entering the field.

Most positions in this field are in government service with all the red tape involved in securing the position one most desires. When positions are filled from general lists, one's luck depends on which agency needs men at the time his name is reached for certification. When positions requiring special college courses and/or experience are involved, no credit is given for reading CIVIL ENGINEERING, the *Architectural Forum*, or all the pamphlets issued by the U.S. Housing Authority.

Leaders in various professions are always making statements as to the great opportunities in their respective fields of endeavor. Very often young men like myself are at a loss as to how to take advantage of these opportunities. Perhaps Mr. Mark and other engineers specializing in housing and city planning could offer definite suggestions.

HERBERT E. BLAKEMAN, Jun. Am. Soc. C.E.
Assistant Naval Architect, Mare Island Navy Yard

Mare Island, Calif.

Basic Engineering Education a Vital Consideration

TO THE EDITOR: Permit me to applaud Dr. Cooley's "A Crisis in Education," in the April issue of CIVIL ENGINEERING. It is not only most authoritative but also most cogent and timely.

In their frantic pursuit of immediate objectives—whether military, political, selfish, or visionary—many in places of high authority or power apparently neglect any consideration of effects other than the one they pursue. When so fundamental a consideration as education is attacked as now, it behooves those leaders not actively in the case to regard carefully the possible concomitants of the rush of the hounds and the after-effects likely to be attendant on the success of the chase itself.

Dr. Cooley has well suggested this. Other responsible educators, if they have not digested his remarks, would do well to consider

them seriously in the midst of the clamor for short-cuts to "Engineers"—"30-day wonders" was once a phrase for them.

Neglect of the constantly growing need for breadth of foundation to engineering education and attempts to eliminate the cultural studies (to shorten the courses), and to force the development of engineering students beyond a reasonable degree of industry (even if a rational weeding of the "book-minded" from the "hand-minded" could be had) can only result in reducing the differences between the professional man and the technician. Such a result would be deplorable from the viewpoint of those who have contributed during the past toward establishing engineering among the "learned professions."

Some thirty years ago the writer submitted to another engineering organization some suggestions along the lines of Dr. Cooley's "More, Not Less, Education." The reaction seemed to be hostile because "it would require more effort from the already overburdened teachers." But times have changed, and under present conditions doubtless a similar objection to Dr. Cooley's words will not be raised. We can hope so at least, and recognize our debt to him for this article.

W. W. CROSBY, M. Am. Soc. C.E.
Consulting Engineer

Coronado, Calif.

Comments on Estimating Flood Frequencies

TO THE EDITOR: The remarks of Prof. W. E. Howland, in the April issue, regarding my article, "A Simple Method of Estimating Flood Frequency," in the February issue, are much appreciated. It is true that not all records plot as a straight line even on this paper, but it is believed that more of them will than would on normal probability paper. If it is evident that a curve gives a better fit than a straight line it should be used, but its extrapolation is more uncertain, and Hazen's method may be preferred, in spite of the extra work.

My attention has also been called to a weakness in the article as published. What is there called the return-period and represented by the letter T, is not the average frequency of all floods of a given magnitude, but only of the annual floods. In some years there will be a second or even a third flood greater than the maximum of some other years, and these should be included if the average frequency of small floods is desired. However, a flood with an average frequency of 10 or 20 years will almost never occur more than once in the same water year. Thus the line drawn in Fig. 1 of my article represents the frequency of all floods from 10 to 20 years and up.

The data for secondary floods at Hartford are not available, but a similar record of 94 years for the Cumberland River at Nashville shows a mean annual flood of 122,000 cu ft per sec; and the annual flood equaled or exceeded this 42 times in the 94 years, which gives an average frequency of 2.24 years as against the theoretical 2.33 (the "2.376 years" in my original article is a misprint for 2.3276). But counting all floods, 122,000 cu ft per sec was equaled or exceeded 56 times in the 94-year period, so that the real average frequency was 1.68 years. An annual flood of 100,000 cu ft per sec was equaled or exceeded 74 times for a frequency of 1.27 years. However, counting all floods of 100,000 cu ft per sec or over, there were 121, so that the frequency was 0.78 years.

If all these floods are plotted on the special plotting paper described, a curved line results. In fact, if it is desired to use these secondary floods it is better to use semi-logarithmic paper. But about twice as many floods are required to give the same accuracy as by the use of annual floods alone.

RALPH W. POWELL, M. Am. Soc. C.E.
Associate Professor of Mechanics,
Ohio State University

Columbus, Ohio

Forum on Professional Relations

CONDUCTED COLUMN OF HYPOTHETICAL QUESTIONS WITH ANSWERS BY DR. MEAD

For some months past Dr. Mead has been answering questions on engineering ethics in these columns. Currently Dr. Mead gives his answer to Question No. 8, which was announced in the March issue. The question states that "An engineer who had purchased a number of shares of stock in a local public service company was asked by the directors of the company to make a report on a project which they had under consideration. The directors of the company were ignorant of the fact that the engineer owned stock in the company. Should the engineer accept the job?"

It should always be a point of honor for the engineer to inform his client or employer fully as to every condition that may affect his judgment concerning any project on which he is asked to report. The fact that he is a stockholder in this utility certainly should be explained to the board of directors before the engineer accepts such an appointment.

On the other hand, the fact that the engineer is a holder of stock in this utility should generally be regarded as a favorable factor so far as an honest and conscientious report is concerned, for under such circumstances the personal interests of the engineer and of the utility would, in general, be the same.

The best answer concerning any project should be given in reply to the specific question: "What would you do concerning this project if you were personally considering the investment of your own money in it?" An honest and conscientious answer to this question is the best one that any engineer can give, and if the answer is in error it will be an honest error.

The writer believes that many projects have been recommended and constructed, which never would have been considered if the investment had involved the engineer's own funds. Such mistakes are due largely to the fact that the engineer may be influenced unconsciously by the consideration that if his report is favorable he will be assured a considerable fee for designing and building the project. This fact may unconsciously warp his judgment and make him minimize the risk involved, possibly underestimate the expenses that will be incurred, and overestimate the possible benefits to be derived. He is far less apt to fall into such errors if he conscientiously answers the question: "What would you do with this project if it were yours?"

Possibly the engineer who is a stockholder in the utility may have an interest in the project to be considered, which would be antagonistic to the interests of the other stockholders. In this case, he could not ethically serve the board of directors in passing on the desirability of the undertaking involved, and under such conditions should refuse the appointment.

D. W. MEAD, Past-President and Honorary Member, Am. Soc. C.E.

Madison, Wis.

Other problems of professional relations will be treated by Dr. Mead each month. Next in sequence, for study and written discussion by members until May 5, with answers in the June issue, will be the following:

QUESTION NO. 10: *The purchasing agent for a large concern purchases a large number of trucks annually. One particular kind of truck has been very satisfactory and is very popular with the purchasing agent. The makers of this truck also make a pleasure car which the purchasing agent is thinking of buying. When he goes to purchase the car, he finds that the dealer, who is also the dealer from whom he buys the trucks, is willing to sell him the pleasure car at a price a great deal lower than that at which the car is ordinarily sold. Should he buy the car at the price offered?*

SOCIETY AFFAIRS

Official and Semi-Official

Dallas Meeting of Texas Section, April 6–8, 1943

Presence of Board and Other Society Members Gives National Aspect

A COLORFUL semi-annual meeting of the Texas Section was held at the Baker Hotel, Dallas, April 6–8. War conditions definitely affected all phases of the meeting. Many Army engineers were in attendance, a welcome feature for which the location of the present Corps Area Headquarters in an adjacent building was in part responsible. The subjects of discussion, both at the technical sessions and at the luncheon, were based on war needs and interests. Doubtless the war also affected the attendance. Nevertheless, the total registration was about 275, a fine record and a tribute to the loyal efforts of the Texas members.

NEW IDEA PROVES SUCCESSFUL

This was not officially a Society meeting. Yet it had many of the attributes of such a gathering. A regional meeting of Local Section delegates occupied all of Wednesday, April 7. The Board of Direction or its committees met throughout April 5, 6, and 7. When war conditions required abandonment of the usual official Spring Meeting, the Board conceived the idea of lending its support to some convenient regular Local Section meeting. The time and place of the Texas Section's semi-annual spring gathering seemed ideal for this purpose. So it proved.

Hotel accommodations were at a premium, yet most of the out-of-town members found it possible to secure rooms at headquarters. A few members of the staff and Board of Direction arrived as early as Monday morning, April 5. During the day three important Board committees were in session—the Executive, Membership Qualifications, and Publications committees. Since the Board itself was to meet early on Tuesday, most of the members, accompanied by a dozen or so ladies, arrived by Monday evening. At first it was thought that the Board might complete its deliberations on Tuesday, leaving members free to participate in Local Section and other activities scheduled for Wednesday. As it worked out, however, the Board spent not only all day Tuesday but also Wednesday until late in the afternoon on Society work and even then was unable to cover all the items of the agenda. A summary of the accomplishments of the Board is given in another item.

Courtesy J. A. Focht

AT THE TUESDAY EVENING RECEPTION, DALLAS MEETING

Left to Right: T. E. Stanton, Sacramento, Calif.; T. E. Huffman, Dallas; John M. Page, Little Rock, Ark.; W. D. Dickinson, Little Rock. Mr. Stanton is a Vice-President of the Society; Mr. Huffman, a Member of the Local Committee on Arrangements; Mr. Page, President of the Mid-South Section; and Mr. Dickinson, a Member of the Society's Board of Direction

Social activities, tinged with technical topics, began as early as Monday noon, when the Dallas branch of the Texas Section held its regular luncheon meeting in the nearby Y.M.C.A. The group of 50 included a number of members of the Board and staff, a group of Army Engineer officers, and many Texas members, largely from Dallas and vicinity, since the opening of the regular technical sessions was still two days off. After a fine meal of fried chicken, Director Ralph B. Wiley was introduced as the main speaker. He took as his subject "The Engineer in Relation to Public Health," discussing this work in America from about 1790 and concluding with an evaluation of the present-day government health service.

At the conclusion of this excellent talk, President E. F. Maddox of the Dallas branch, called on Society President Whitman, who gave a few personal reminiscences, mostly on sanitary work, dating back to his first experience forty years ago in Texas.

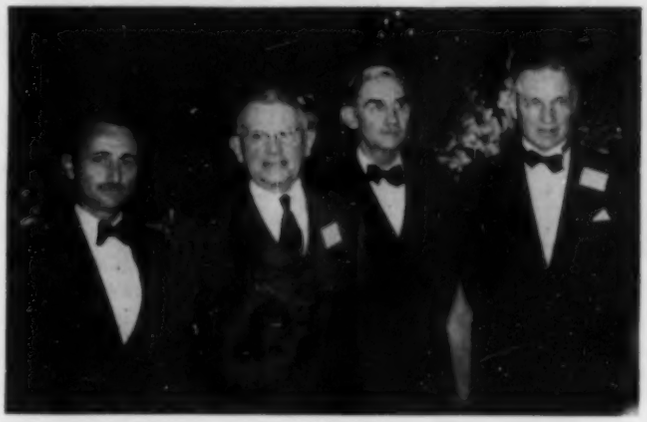
Courtesy J. A. Focht

AWARD OF A LIFE MEMBERSHIP CERTIFICATE

R. J. Cummins of Houston (left) after giving citation to H. R. Safford, Houston (right) as new Life Member. Three days later, Mr. Safford died at Hot Springs, Ark. He was Executive Vice-President of the Missouri-Pacific Lines

Mention must also be made of another fine lunch the following day, Tuesday noon, given by the Dallas Technical Club, an association of all types of engineers in Dallas. Again the luncheon was splendid—this time it was chicken fricassee. The attendance of 30 local members of the Technical Club, plus 30 guests, just about filled the room assigned. Concluding the lunch, Director Rawn gave a short talk covering the development of American engineering, with emphasis on the sanitary advances. His interesting talk seemed particularly apropos, especially to those who were aware of his recent appointment to an important government position as chief of the new Sewerage and Sanitation Section established by the Governmental Division of the War Production Board.

As its first official activity, the Texas Section held an informal dinner at the headquarters hotel on Tuesday evening, entertaining the members of the Board and their ladies as its guests. Early registrants for the Local Sections Conference the next day were also invited. A hundred or more people enjoyed a fine turkey dinner. This was followed by a few brief speeches but no formalities. The entire party then adjourned to the roof garden of the hotel, where an informal reception was held. Some impromptu singing was enjoyed but in general the evening was devoted to pure sociability in smaller or larger groups. It was an excellent occasion for meeting new friends and enjoying old ones.



Courtesy J. A. Focht

LIFE MEMBERSHIP CEREMONY IN DALLAS, WEDNESDAY, APRIL 7

Left to Right: Grayson W. Gill, Member of Local General Committee, who introduced J. L. O'Hearn, new Life Member, Secretary-Treasurer of Dallas Branch, Texas Section; John H. Bringhurst, President, Texas Section; and E. B. Whitman, President of the Society

All day Wednesday, until late in the afternoon, was devoted to round-table discussion at the Local Sections Conference. An accompanying photograph shows this group, also the delightful surroundings in the Texas Room at the headquarters hotel. All the technical sessions were also held in this room. John A. Focht, Secretary of the Texas Section, presided. After a brief welcome from Mayor Rodger of Dallas, and from President Bringhurst of the Texas Section, the meeting settled down to a consideration of many topics of interest to Local Sections. The program was long but was chock-full of valuable discussion. The following are some of the topics treated: Employer-Employee Relationships, Outlook for Civil Engineers After the War, Should the Engineering Profession Be Restrictive? Duties and Records of a Local Section Secretary-Treasurer, Effect of War Upon Local Section and Student Chapter Activities, Junior Forums—Their Programs and Relationship to Local Sections. The only interruption in the regular

LUNCH OF TEXAS SECTION AND GUESTS, ADOLPHUS HOTEL, DALLAS, APRIL 7

LOCAL SECTIONS CONFERENCE AT THE BAKER HOTEL, DALLAS, TEX., APRIL 7
Those Seated Are Mostly Delegates and Speakers, Standing Are Some Delegates and Many Interested Visitors

conference procedure was the interesting brief address by President Whitman immediately upon the return from lunch.

For luncheon about 120 adjourned to the nearby Adolphus Hotel. Part of this group is also shown in an accompanying photograph. After a turkey meal and a few introductions, the main address was given by Colonel Julien C. Hyer of the Eighth Service Command. His was an eloquent and inspirational speech on the war, designed to stir the audience out of any feelings of complacency. It was very well received. After lunch the party returned to the Baker Hotel for the afternoon.

The official dinner held that evening at the headquarters hotel was the largest social event of the meeting. About 200 were in attendance. Following a fine dinner (chicken, this time) President Bringhurst introduced Professor R. E. Jackson, a teacher at the Texas State College for Women, who gave a humorous after-dinner speech. The main event of the evening, however, was that immediately following—the presentation of Life Membership Certificates by President Whitman to J. S. Barlow, J. H. Brillhart, William Grant, J. L. O'Hearn, and H. R. Safford. In each instance the new Life Member was introduced with an appropriate appraisal of his technical and civic accomplishments given by an associate, and followed by the official presentation from the hand of the President

TEXAS SECTION TAKES OVER

Up to this time, except for some of the social gatherings, the Texas Section as such had not had any official gathering. But all of Thursday, April 8, was devoted to the Section's interest and activity. In the morning the main discussion revolved around the subject of Employment Conditions for Engineers. Then followed a business session of the Section, which in fact extended briefly into the afternoon.

For lunch the party adjourned to another room on the same floor of the hotel, where a joint gathering was held with the Dallas post of the Society of American Military Engineers. Again the meal was excellent. By some inadvertence, the pièce de résistance was fish, thus interrupting a record run of five consecutive poultry meals, not counting breakfast—a generally satisfactory solution of the meat rationing problem, most members agreed. The only speaker was President Whitman. He recalled many interesting war experiences, beginning with his duties as Major in the Quartermaster Corps in the First World War and continuing with similar anecdotes covering his important consulting projects in the present conflict. A large number of Army officers, many of them from nearby Area headquarters, gave this lunch a colorful atmosphere.

Immediately following, President Bringhurst called the afternoon technical session to order. Brief business came first, then technical discussions of "Post-War Planning," followed by four papers on soils or foundations, all as previously announced. This ended the semi-annual meeting of the Texas Section. During the afternoon, some of those in attendance, especially members of the Board, had to leave somewhat early in order to make connections for the Birmingham meeting scheduled for the following day.

Difficulties of transportation naturally handicapped the activities of the ladies. Some luncheon and shopping trips were taken informally, also visits to surrounding points of interest. The main event was a splendid luncheon at the headquarters hotel, followed by a style show put on by the Nieman-Marcus Company, nationally known Dallas department store. The group of local members' wives was well organized. They not only gave their visitors a warm welcome but helped them in every way possible to enjoy their stay in this interesting city.

Looking back on this series of meetings, tied in with the business and social activities of the Texas Section, the outstanding impression is that of a loyal and enthusiastic Society group doing a fine job in their own area. A goodly number of outside Society members and a generous representation of the Board enjoyed the whole program, not to mention staff members. If this meeting is any augury of the future, this type of combined and quasi-national gathering will be a huge success.

Meeting of Board of Direction—Secretary's Abstract, April 6 and 7, 1943

THE BOARD of Direction held its spring meeting at the Baker Hotel, Dallas, Tex., on April 6–7, 1943, at the time of the Texas Local Section's semi-annual meeting. Present were President Ezra B. Whitman as chairman, and George T. Seabury, Secretary; also the following members: Past-Presidents Fowler and Black; Vice-Presidents Spofford, Stanton, and Agg; and Directors Bakenhus, Boughton, Breed, Burpee, Carey, Cunningham, Dickinson, Dougherty, Edwards, Goodrich, Howard, Lilly, McNew, Rawn, Requardt, Scobey, and Wiley.

Minutes Approved

Approval was given to the minutes as written covering the Board meetings of January 18–19, and 21, 1943.

Local Section Administration

Following regular request from the Sections concerned, approval was given to amendments to the constitutions of the Pittsburgh and Los Angeles Sections.

Highway Division Officers

The unexpired term of the late Col. C. E. Myers on the Executive Committee of the Highway Division (his death occurred while he was in military service) was filled by the appointment of Dean Gibb Gilchrist of College Station, Tex.

Government Activity in Sanitary Engineering

At the time of its meeting in January, the Board, at the suggestion of the Sanitary Engineering Division, adopted a resolution (March issue, page 152) calling upon the Governmental Division of the War Production Board to give active consideration to the establishment of procedures which would strengthen the service it renders in the fields of sewerage and sanitation. It was reported to the Board that conversations held with the Hon. Maury Maverick, Director of that Division, and a subsequent report made to him by three members of the Society, experts in sewerage and sanitation, had met with his approval and that he was in process of appointing a capable man skilled in these subjects to administer the new unit.

Conference on Engineering Positions

In 1939 the Board authorized the inauguration of a National Conference on Engineering Positions, the purpose of which was to formulate a schedule of classifications of related salaries for engineers. Several engineering societies were invited to participate with the Society in the collection of data and in arriving, if practicable, at helpful determinations. Owing to the conditions which have prevailed in the last two years particularly, and which seem likely to continue for the duration of the war, it was decided that

the program as planned is impracticable of accomplishment at the present time, and the collaborating organizations and their representatives were advised accordingly.

Officers Reelected

In accordance with the Constitution, the appointment of a Secretary and Treasurer of the Society is to be made at the meeting of the Board held subsequent to the Annual Meeting. The present incumbents, George T. Seabury as Secretary, and Charles E. Trout as Treasurer, were reappointed.

Pan American Engineering Comity

It was decided to cooperate, if such cooperation shall be desired, with the Engineering Societies of South America in a proposed biannual or tri-annual congress of all the engineering societies of both North and South America.

Society's Summer Meeting

The Board of Direction decided to hold its summer meeting at Los Angeles, probably in the latter part of July, at the time of the summer meeting of that Section. For further details, see a separate item in this section.

Financial Items

Several matters relating to the budget and the financial operations of the Society received consideration and were dealt with as was deemed appropriate. Cancellation of 1943 dues to 240 members of the Society in the armed services having a base pay of $2,400 or less was authorized.

Publications Problems

The report of the Committee on Publications advised of several procedures necessary to conform to the federal regulations that the tonnage of paper used in the Society's publications be limited to 10% less than that used in the year 1942. A specific complication was that because of an increase of more than 1,800 members since the printing of the 1942 Yearbook, additional pages were required in the alphabetical and geographical listings. This, combined with a similar increase in the circulation, made it necessary to reduce much material in the fore part of the Yearbook in order to effect the net 10% reduction in weight required by the Government.

Professional Conduct

The Committee on Professional Conduct reported on four matters which had been referred to it for consideration, appropriate action being taken by the Board in each instance.

Amendments to By-Laws in Process

Notice was given of proposed amendments to the By-Laws in regard to Articles V, Student Chapters, and VIII, Technical Divisions. These proposed amendments will receive consideration at the July meeting of the Board.

Postwar Public Works

A letter from the President to the Chairman of the National Committee for Economic Development was authorized, indicating the Board's belief that the consideration of worth-while public works by states, counties, municipalities, and to an appropriate extent by the federal government, would be essential in the economic development of the country at the close of the war.

Student Chapters

Approval was given to the establishment of a Student Chapter at the University of Toledo. Realizing that some of the Student Chapters might have difficulty during the present accelerated programs, the Board authorized the Committee on Student Chapters to relieve such Chapters as it felt were incapable of operating efficiently by placing them on an inactive list from which they would be removed, so as again to become active, when circumstances should permit.

To Safeguard Engineering Education

As recommended by the Committee on Engineering Education, a communication is to be addressed to the appropriate officials of the Army and Navy in regard to the training of engineers for the Armed Services. The basic thought is that present procedures by the Army, and to a lesser degree by the Navy, will not provide the reserve of trained men who will be needed for the prosecution of the normal activities of the country when the war is over.

Civil Engineers for the Armed Services

Having been informed of numerous cases where trained engineers, many with considerable experience, have been given inappropriate assignments in the armed services, the Board urged that there be established a Procurement Board for Engineers similar to that now in operation for the procurement of medical officers. In this manner those who have had training and experience in engineering may be allocated to units or positions where their experience and ability may be most effective in the war effort. The form of this communication is noted on another page.

Approval of Building Code

At its January meeting, the Board considered, but did not approve, a proposed American Standards Building Code for structural steel (riveted or bolted construction), designated as A 57/7. The same code, extended into the field of welded construction, known as A 57/8, was again studied and received the Board's approval.

Committee on Postwar Planning

Officers of the Construction Division suggested a program for immediate preparation of plans for postwar public works, as well as conversion of industrial plants, designed for prompt adoption at the cessation of military activities. Other plans for averting hardships in the postwar period received the consideration of the Board. Approving these efforts, it authorized a committee on postwar planning to which the several plans were directed to be referred, studied, and reported upon at the Board's next meeting.

GROUP OF SOCIETY OFFICERS AT BOARD MEETING IN DALLAS, TEX., APRIL 6

Left to right, front row: Past-President Frederick H. Fowler; President Ezra B. Whitman; Past-President E. B. Black. Rear row: Vice-President T. R. Agg, Zone III; Vice-President Thomas E. Stanton, Zone IV; Vice-President Charles M. Spofford, Zone I; Secretary George T. Seabury

Staff Activities

Bills already introduced or in prospect of introduction into the Congress of the United States, which appear to relate to the pursuits and welfare of the engineering profession in general and more especially to those of civil engineers, were reported on in detail by the Society's representative stationed in Washington, D.C. A similar report in confidential detail was presented with respect to problems concerning engineer employer-employee relations, on which a member of the Society's staff has been engaged, as conciliator, where circumstances have permitted rectification of the difficulties.

Other Matters

The Board was in receipt of reports from several of its committees, and individual actions were taken as deemed appropriate, with the allotment of the necessary funds.

Adjournment

The Board adjourned until its regular meeting in July, scheduled for Los Angeles, Calif.

Official Visits to Local Sections

THE ATTENDANCE of national Society officers at meetings of Local Sections has been considerably curtailed during the war; but this was in part compensated for, at least in the case of some of the eastern and central areas of the country, by a series of visits following the Dallas Meeting of the Board. Including in particular three members of the staff, these trips accomplished at reduced expense a fairly wide coverage.

In addition a number of Board and staff members stopped over at the Birmingham meeting of the Alabama Local Section, April 9 and 10. The party included President Whitman, Vice-President Spofford, Directors Breed and Edwards, and Messrs. Jagger, Peckworth, Hale, and Wilmot of the staff. Many of them took part in the official program, as noted elsewhere in these pages.

More extended trips, however, were taken by Messrs. Seabury, Jagger, and Peckworth. It will be noted that Mr. Seabury covered the Coast districts, Mr. Jagger the Gulf, Tennessee Valley and Ohio Valley areas; and Mr. Peckworth the Missouri and Upper Mississippi valleys. An outline schedule of these visits follows:

MR. SEABURY

Dallas, Texas (Texas Section)	April 8
New Orleans, La. (Louisiana Section)	April 9
Jacksonville, Fla. (Florida Section)	April 11
Columbia, S.C. (South Carolina Section)	April 13
Raleigh, N.C. (North Carolina Section)	April 14
Richmond, Va. (Virginia Section)	April 15
Washington, D.C. (District of Columbia Section)	April 16

MR. JAGGER

Dallas, Texas (Texas Section)	April 8
Birmingham, Ala. (Alabama Section)	April 9–11
Tuscaloosa, Ala. (Univ. of Ala. Stud. Chap.)	April 12
Auburn, Ala. (Ala. Poly. Inst. Stud. Chap.)	April 13
Atlanta, Ga. (Ga. Tech. Stud. Chap. & Georgia Section)	April 14
Knoxville, Tenn. (Univ. Tenn. Stud. Chap.)	April 15
Nashville, Tenn. (Nashville Sect. & Vanderbilt Univ. Stud. Chap.)	April 16, 17
Lexington, Ky. (Univ. Ky. Stud. Chap. & Ky. Sect.)	April 19
Cincinnati, Ohio (Cincinnati Section)	April 20
Dayton, Ohio (Dayton Section)	April 20
Columbus, Ohio (Ohio State Univ. Stud. Chap., Central Ohio Section)	April 21

MR. PECKWORTH

Dallas, Texas (Texas Section)	April 5–8
Birmingham, Ala. (Alabama Section)	April 9–12
Oklahoma City, Okla. (Oklahoma Section)	April 13
Stillwater, Okla. (Okla. A. & M. College Stud. Chap.)	April 14
Norman, Okla. (Univ. Okla. Stud. Chap.)	April 15
Eudora, Kans. (Employment Conference)	April 16
Kansas City, Mo. (Employment Conference)	April 17
Lawrence, Kans. (Employment Conference)	April 17
Lincoln, Nebr. (Univ. Nebr. Stud. Chap.)	April 19
Ames, Iowa (Iowa State College Stud. Chap.)	April 20
Iowa City, Iowa (Univ. Iowa Stud. Chap.)	April 21
Chicago, Ill. (Employment Conference)	April 23

These visits are the result of an effort to present the Society's condition and activities to interested local groups. The size of the meetings was not considered the important feature. In fact they were occasionally small, including only local officers and interested members. In the aggregate, a large coverage of Society Local Sections was accomplished and much useful information was imparted—all at a relatively moderate cost.

War Procurement Board for Engineers Suggested

MUCH CONCERN was expressed at the Dallas meeting of the Board as to the best means of utilizing to the fullest the abilities of engineers in the armed services. The problem is how to fit men with special qualifications into services or fields where they can produce for the war effort to maximum advantage. In general this means putting them into some branch where their civilian training and experience makes them especially valuable.

After much discussion, a brief communication was evolved expressing the Board's ideas on the proper assignment of engineers in the war program. This was expressed in the following brief communication:

"WHEREAS the Board of Direction of the American Society of Civil Engineers is greatly concerned over the rapid depletion of the reserve of experienced engineers in the United States; and

"WHEREAS it is aware that progress is further handicapped by lack of an adequate plan for utilizing trained and experienced engineers to best advantage in the war program; now therefore,

"*Be it resolved* that the Board urges (1) that a procurement board for engineers similar to that now in operation for procurement of medical officers be established; and (2) that it be constituted and operated in like manner to that for medical officers."

As directed by the Board, this recommendation has been forwarded to the War Manpower Commission.

Return Back Copies

AS EXPLAINED last month in CIVIL ENGINEERING, the paper shortage is now affecting the number of copies printed of both CIVIL ENGINEERING and PROCEEDINGS. In this emergency the Society is hard pressed to fill the orders received for these publications, and has called on members for their cooperation.

Where more than one copy goes to a household, an engineering firm, or other group, it would be a great help if the extra copy or copies could be returned to Headquarters. Postage charges will be gladly refunded. A number of members have sent back their copies of the March and April issues but more are still needed.

Another suggestion is that the member keep his copy for one month, so as to have full opportunity to read it at his leisure, and then return it when he receives the next issue, in the envelope which contained the latter. By this means, members would have full current benefit of Society publications, and at the same time the Society's stock would be replenished. Each copy returned will be sent out to another engineer member whose name was not on the mailing list when the issue was originally circulated.

The numbers now especially needed are the January, March, and April 1943 issues of CIVIL ENGINEERING, and the March and April issues of PROCEEDINGS. For instance, by April 15 the stock of the April issue of CIVIL ENGINEERING was completely exhausted.

Activities of E.C.P.D. Summarized

INTERESTING and useful reference material on what engineers are doing in selecting and training new personnel for the profession and in elevating the status of engineers in general is contained in the Tenth Annual Report of the Engineers' Council for Professional Development recently issued. The Council is a joint agency of the professional societies of civil, mechanical, electrical, and mining and metallurgical engineers (known as the four Founder Societies); and of the chemical engineers, the engineering educators, the state licensing boards, and the Engineering Institute of Canada. The Council recently held its tenth annual meeting in New York City, and the principal reports presented at that meeting are here outlined.

Included in the Tenth Annual Report is a list of engineering curricula approved by E.C.P.D. as of October 18, 1942. The curricula so accredited were those functioning before the recently announced Army and Navy college training programs became operative. A total of 551 curricula, at 131 institutions, are currently on the approved list. In addition, several other curricula, such as aeronautical and industrial engineering, are listed as options to the regular courses in some of the older curricula.

In his report, Robert E. Doherty, E.C.P.D. chairman, and president of the Carnegie Institute of Technology, reviewed the activities of the year and the functions of the Council as they relate to present world conditions, and referred to the work of the several committees. Especially he referred to the E.C.P.D. conference held in September to discuss the problems of engineering manpower. At this conference were representatives of several government agencies who are advisory to the War Manpower Commission regarding the reserves of professional and scientific men. Also present were representatives of a number of war industries employing large numbers of engineers. As a result of this conference,

a resolution was forwarded to the War Manpower Commission urging a more efficient use of available engineers and suggesting means for increasing their number.

The Committee on Student Selection and Guidance (R. L. Sackett, chairman) reported continuing assistance in the guidance of high-school students toward a better knowledge of the engineering field. In particular it summarized the findings in its study of tests and aptitudes of both arts and engineering students, as carried out in representative universities and high schools during the previous year.

Besides indicating progress in its usual activities, the Committee on Professional Training (Everett S. Lee, chairman) emphasized a new project—a manual for junior engineers—the preparation of which is now being undertaken. The Committee on Professional Recognition (Charles F. Scott, chairman) reported activity in its program of stressing the professional phases of the engineer's life. To this end over 10,000 copies of an address by President W. E. Wickenden, of the Case School of Applied Science, were sold, and the committee was also instrumental in having the address reprinted in several engineering society journals.

Certain "Canons of Engineering Ethics" proposed by the Committee on Principles of Engineering Ethics (D. C. Jackson, chairman) are included in the E.C.P.D. report. This attempt to formulate ethical standards for engineers in a written code follows similar codification of principles by some other professional groups. These canons have been referred to the boards of the constituent organizations for suggestions or acceptance.

Statements by representatives of the eight constituent societies in E.C.P.D. are also included in the report, as is also an account of the Council's annual dinner. The retirement of R. L. Sackett, dean emeritus of engineering, Pennsylvania State College, from the chairmanship of the Committee on Student Selection and Guidance after ten years was noted, the dinner report containing a tribute to him.

Alabama Section's Spring Meeting in Birmingham, April 9 and 10

BECAUSE the Alabama Section, at its regular spring meeting, entertained a number of Society officers and several members of the staff returning from the Dallas meeting, much interest attaches to this event, which was specially arranged to accommodate these visitors. Sessions were held at the Hotel Thomas Jefferson, beginning at 2 p.m. on Friday, April 9, and continuing until about noon on Saturday, April 10. The visitors arrived in Birmingham shortly after the meeting had started, and so unfortunately they lost part of the first session.

The afternoon program began under the guidance of W. N. Woodbury, Past-President of the Section. As the first scheduled speaker, J. P. Ewin, had to be absent on government business, his address was omitted. In its stead, a technical paper on "Alinement Charts for the Solution of Industrial Problems" was delivered by H. A. Davies, Assoc. M. Am. Soc. C.E. A second paper was presented by L. M. Miller, Assoc. M. Am. Soc. C.E., covering "Some Highlights on the Birmingham Aircraft Modification Center," following which he answered a number of questions. At this point a special topic was introduced—the need of the Navy and the Army for engineers. The viewpoint of the former was presented by Lt. Swayze of the Navy, Procurement Branch, and that of the latter by Lt. Col. Rawson and Capt. Little of the Army.

The final paper of the afternoon was by one of the visitors, Prof. C. B. Breed, Director of the Society. This dealt with the "Post-War Effect of Air Transport on Railroads," and also was freely discussed. The session adjourned in time to permit preparation for the Section dinner scheduled for 6.30 p.m. in a neighboring room at the headquarters hotel.

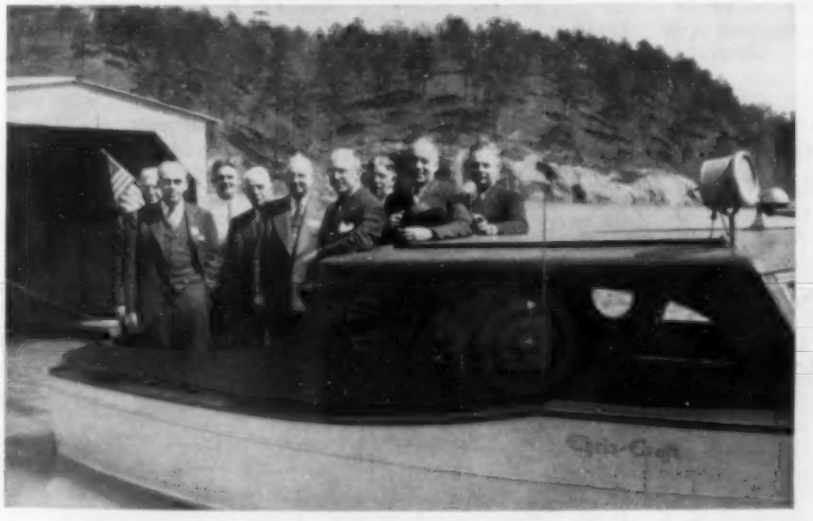
About 125 were present at the dinner and the meeting which followed. At the dinner, J. B. Converse, First Vice-President of the Alabama Section, made a gracious presiding officer. The exercises were brief and quite informal. Many of the visitors and their ladies were introduced but no set speeches were requested. The formal part of the program was reserved for the evening meeting.

This was conducted by Prof. T. M. Lowe, President of the Alabama Section. He introduced Col. A. C. Polk, former Director of the Society, who in turn presented as the principal speaker Ezra B. Whitman. Taking as his topic, "What Lies Ahead of the Civil Engineer," the President of the Society drew upon his personal experience for lessons applicable to the present day. He recalled his college days in Ithaca, N.Y., and early sanitary engineering practices in Baltimore. From these recollections of what lay behind, he went on to develop his expectations for the future. In particular he mentioned the great opportunities of the civil engineer in post-war planning.

The second and final technical session was held Saturday morning, April 10, with Carl A. Wilmore, director of the Section, in the chair. A paper on "Non-Critical Materials in Wartime," by J. W. Goodwin, opened the meeting. After it was discussed, the remainder of the morning was spent considering Society activities as presented by three of the Headquarters staff, in the following order: Employer-Employee Relationships, by Howard F. Peckworth; the Situation in Washington, by Hal Hale; and the outlook for the Society, by J. E. Jagger. Responding to Mr. Peckworth's presentation, James F. Barrett, now in government work on leave from his regular duties with the American Federation of Labor, gave his ideas as representing the labor union viewpoint on the subject of employee-employer relationships.

Starting shortly after noon, a small party of visitors were privileged to inspect the new Inland Dam, with its reservoir of Blackburn Lake, part of the Birmingham Industrial Water Supply System. The willingness of local engineers to use up some of their precious gas to transport the visitors thirty-five miles north of Birmingham and back to view this interesting objective was greatly appreciated.

This courtesy was typical of the hospitable attitude of the Alabama Section. Visitors from outside the state felt well repaid for making this slight detour in their itineraries from Dallas. It goes without saying that the Alabama members also enjoyed their annual spring meeting. The registration of 150 bears testimony to the success of the event.



MOTOR BOAT INSPECTION OF BLACKBURN LAKE, MAIN SOURCE OF BIRMINGHAM INDUSTRIAL WATER SUPPLY, SATURDAY AFTERNOON, APRIL 10, FOLLOWING ALABAMA SECTION MEETING

Left to Right: G. N. Mitcham, Aniston, Ala. (in rear); J. E. Jagger of the Society's Staff; G. R. Kavanagh, of Knoxville, Tenn.; W. G. McConnel, Fairhope, Ala.; A. Clinton Decker, Birmingham, Ala.; H. F. Peckworth, of the Society's staff; J. D. Webb, City Engineer, Birmingham, Ala.; Dean G. Edwards, New York, N.Y.; W. F. Rooney, New York, N.Y.

Congratulations to Canadian *Journal*

TWENTY-FIVE years ago, the *Engineering Journal*, official mouthpiece of the Engineering Institute of Canada, was inaugurated. Its current May issue thus constitutes an anniversary number. CIVIL ENGINEERING is glad to join with others in extending congratulations on this significant event.

The Institute itself was founded in 1887, but throughout all its early years the records were maintained in the form of *Transactions*. It was in 1918, during a period very similar to the present, that the council of the Institute thought a monthly mouthpiece was required. Thus the *Journal* was instituted. In the intervening years it has continued to grow in scope and in importance.

Professional ties between the Society and the Institute are especially strong. The recent joint meeting last October at Niagara Falls, Ontario, was but another indication of this happy relationship. Many engineers in the United States and Canada are members of both organizations, and the staffs of the two bodies have been privileged to cooperate in numberless ways.

Thus it is with considerable satisfaction that American engineers can contemplate the accomplishment of a full quarter century on the part of the *Engineering Journal*. The present is an appropriate time to express all good wishes for its continuing prosperity.

Skilled Workmen for Army Engineers

ACCORDING to the Chief of Engineers, Maj. Gen. E. Reybold, M. Am. Soc. C.E., the biggest job of emergency construction America has ever seen is winding up. The Corps now needs, in the next step towards victory, 9,000 construction workers—specialists—each month, many of whom will doubtless be found in the men soon to be inducted.

To expedite the classification of such construction experts into positions where they will be of greatest service, the Corps has arranged to interview in advance volunteers with special skills. The proper assignment may then be made in time—that is, before a draft board orders induction. In this way their allocation, their training, their promotion, and their opportunity to secure commissions will be greatly facilitated.

This information has been distributed to the Local Sections of the Society so that they may spread it among those who can profit most. Individual members also may assist by passing the word along to all groups in the construction industry. Interviews for the men concerned may be had at any of the Regional Offices of the Corps of Engineers. The important point is that such specialists should pursue this matter before, rather than after, their Selective Service order number comes up. By so expediting this project, they will, in the words of General Reybold, "be of inestimable aid in helping to plan the wisest possible use of America's skilled manpower."

Past-President Endicott Honored

AT A DEDICATION ceremony on April 4, the U.S. Naval Construction Training Center in Rhode Island was named Camp Endicott in honor of the late Rear Admiral Mordecai T. Endicott. Admiral Endicott, who was president of the Society in 1911, was the first Chief of the Bureau of Yards and Docks to be appointed from the Civil Engineer Corps. The dedication was made on the 45th anniversary of Admiral Endicott's appointment to this post.

Rear Admiral Ben Moreell, Hon. M. Am. Soc. C.E., present Chief of the Bureau of Yards and Docks, in his dedicatory address described Admiral Endicott as a "disciple of progressive thought and vigorous action." To quote Admiral Moreell further:

"Born at Mays Landing, N.J., November 26, 1844, Admiral Endicott was a descendant of John Endicott, governor of the Massachusetts Bay Colony. He was educated at Rensselaer Polytechnic Institute and after several years of experience as a mining engineer, he was appointed as Assistant Civil Engineer, at the new League Island Naval Yard, Philadelphia.

"He was commissioned in the Navy as a Civil Engineer in 1874. It was during this period that the Navy yards were undergoing extensive modernization and Admiral Endicott had exceptional opportunities to show his professional skill and insight.

"Among his achievements was the completion of the floating drydock *Dewey*, largest of its type to be built. He served on the Nicaragua Canal Commission in 1895, was Navy member of the Panama Canal Commission, 1905, 1907, and was president of the American Society of Civil Engineers, 1911. Retired in 1909, he returned to active duty during World War I."

Camp Endicott will train officers and men of the Seabees, naval construction battalion. The credit for the formation of these units has been given to Admiral Moreell.

Summer Gathering in Los Angeles

AT THE Dallas meeting of the Board of Direction, action was taken looking toward a meeting in Los Angeles in July at which members of the Board will join with the Los Angeles Section and such other Society members from nearby as may find it practicable to attend. This joint meeting is in response to considerable demand from the West Coast members.

One feature will be a conference of representatives from the fourteen Local Sections in the Pacific area. A strong technical program, directed toward the winning of the war, is also in prospect. Officers of the various Divisions interested will collaborate with members in Los Angeles in arranging topics and speakers.

In accordance with the Constitution, a Society business meeting will be called, probably for Wednesday, July 28. Summer meetings are designated Conventions in order that an opportunity may be given those in attendance to hold such a business session as may be required. Also, this is the occasion when the President is to present his annual address.

The time tentatively chosen is the week of July 25. Society and Local Section officials on the West Coast are now perfecting plans for the program. Further detailed announcements may be expected in due course.

The Engineer in Foreign Service

VI. Society Publications Reach Iran

The delivery of mail in distant lands, with remarkable regularity despite wartime difficulties, has provoked numerous commendatory comments. From an engineer in Iran, L. M. Winsor, M. Am. Soc. C.E., has come the following tribute to the mail service. Mr. Winsor's experiences in Iran have been related in letters to friends, and excerpts appeared in CIVIL ENGINEERING *for September 1942, page 523.*

I WANT to thank you for keeping me informed as regards engineering activities in America. Your communications and publications have come thru regularly, and with less delay than any mail I have received. I am enclosing some blank forms you sent for my attention. Sorry for the long delay. I have been on a long field trip. . . .

My work here is going forward very well. I have been received with genuine enthusiasm in all parts of Iran and have overcome the many handicaps that prevented me from doing effective work in the beginning. I came here as special advisor to the Minister of Agriculture; but I found that my time would be wasted if the administrative work were left with local officials due to insurmountable formalities. Therefore they have consolidated all of the irrigation departments—formerly there were three—and have made me director general, with full and independent authority. By this means I have more power and authority than is enjoyed by any of the Ministers except only the Minister of Finance, who controls all the funds.

I am now working on a ten-year program of irrigation development, and field work on this year's outline is now under way.

My best regards to you all,
L. M. WINSOR

P.S. I have requested Mrs. Winsor to send in my annual dues. I trust that the check has been received. I surely want to receive the publications without any break, for they contain the essence of the activities of importance. Please keep them coming.

I have some interesting material on ancient engineering and construction in this country that I shall endeavor to put in shape for publication as soon as I have an opportunity. Trouble now is censorship, and I want to send pictures when the way is open for doing so, which, please God, will not be long. Please give my kind regards to my many friends of the N.Y. office.

Sincerely,
L. M. W.

News of Local Sections

Scheduled Meetings

ARIZONA SECTION—Technical meeting at the Pioneer Hotel on May 1, at 10 a.m.

CENTRAL OHIO SECTION—Luncheon meeting at the Fort Hayes Hotel on May 20, at 12 m.

CLEVELAND SECTION—Dinner meeting in the Cleveland Engineering Societies Restaurant on May 14, at 6:30 p.m.

DAYTON SECTION—Luncheon meeting at the Engineers' Club on May 17, at 12:15 p.m.

ILLINOIS SECTION—Joint meeting with the Western Society of Engineers on May 6, at 7 p.m.

INDIANA SECTION—Dinner meeting in the State Board of Health Bldg. on April 30, at 6:15 p.m.

KANSAS SECTION—Meeting at Topeka, Kans., on May 21.

LOS ANGELES SECTION—Dinner meeting at the California Institute of Technology, Pasadena, on May 12, at 6:15 p.m.

MARYLAND SECTION—Dinner meeting at the Engineers' Club on May 11, at 5:30 p.m.

METROPOLITAN SECTION—Technical meeting at New York University on May 19, at 8 p.m.; meetings of the Junior Branch in the Eng. Soc. Bldg. on May 10 and 24.

MIAMI SECTION—Dinner meeting at the Seven Seas Restaurant on May 6, at 7 p.m.

NORTHWESTERN SECTION—Dinner meeting at the Campus Club, University of Minnesota, on May 3, at 6:30 p.m.

PHILADELPHIA SECTION—Dinner meeting at the Engineers' Club on May 11, at 6 p.m.

PROVIDENCE SECTION—Talk on "The Sewage Treatment Works at Cranston, R.I.," in the Providence Eng. Soc. Bldg. on May 12, at 8 p.m.

SACRAMENTO SECTION—Regular luncheon meetings at the Elks Club every Tuesday at 12:15 p.m.

ST. LOUIS SECTION—Tentative plans for a meeting on May 24.

TENNESSEE VALLEY SECTION—Dinner meeting of the Chattanooga Sub-Section at the Ross Hotel on May 10, at 6 p.m.; dinner meeting of the Knoxville Sub-Section at the S. and W. Cafeteria on May 11, at 5:45 p.m.

TEXAS SECTION—Luncheon meeting of the Dallas Branch at the Y.M.C.A. on May 3, at 12:15 p.m.; luncheon meeting of the Fort Worth Branch at the Blackstone Hotel on May 10, at 12:15 p.m.

WEST VIRGINIA SECTION—Technical meeting and inspection trip at West Virginia University, Morgantown, on May 7, at 3 p.m.; dinner meeting at 6:30 p.m.

Recent Activities

ALABAMA SECTION

A joint meeting of the Section and the Student Chapter at Alabama Polytechnic Institute took place at Auburn on February 26. The joint session was called to order by Emil Hargett, Student Chapter president, who had arranged a program of student papers. Those taking part included Cullen Harris, Edwin Rogers, Henon Pearce, and Preston Jenkins. A short talk on what the Society means to the engineer was then presented by Clinton Decker, while Messrs. W. N. Woodbury and T. F. Hobart discussed the activities of the Society. Before the meeting T. M. Lowe, president of the Section, entertained the board of directors at his home at dinner.

BUFFALO SECTION

On March 16 George E. Symons, chief chemist for the Buffalo Sewer Authority, reviewed for the members a recent book entitled *The Stone That Burns*—a story of the American sulfur industry. He then described, from personal observation, sulfur mines in Texas and Louisiana. During the business session Dr. Symons resigned as secretary of the Section after several years of service. His unexpired term will be filled by Martin H. Brennan.

CINCINNATI SECTION

An illustrated lecture on "Timber Connector Construction" comprised the technical program at the March 15th meeting of the Section. This was given by Laurence P. Keith, structural engineer for the Timber Engineering Company, of Chicago. Mr. Keith stressed the value of timber in replacing steel in emergency construction operations and showed a supplementary sound film, depicting the source of timber and examples of the many products made from wood. During the annual election of officers the following were selected: R. W. Renn, president; Henry Kercher, vice-president; and Warren W. Parks, secretary-treasurer. It was announced that Boise Ford Macon and Robert Theodore Howe, respectively president and vice-president of the University of Cincinnati Student Chapter, are winners of the Section's prizes of Junior membership in the Society.

CLEVELAND SECTION

At the March luncheon meeting Homer A. Humphrey, of the Portland Cement Association, discussed soil cement and its contribution to the war program. First developed as a base course for secondary county roads and parking areas, soil cement came into its own with the advent of the war, Mr. Humphrey pointed out. In particular, soil cement is now used for paving airport runways. A moving picture showing the various types of equipment used in the construction of soil-cement pavements supplemented the talk.

COLORADO SECTION

A talk on explosives comprised the technical program at the dinner meeting held on March 8. This was given by Ray H. Summer, of E. I. du Pont de Nemours and Company, Inc., who stated that the use of explosives is required in many divergent fields—mining, road and building construction, and seismology, to mention a few. It is estimated that every mile of highway built requires a thousand pounds of dynamite, and for every barrel of cement produced a quarter of a pound of explosives is required. Commercial explosives have advanced considerably, as compared with the old black powder days, to the present varied types of concentrations and sizes.

ILLINOIS SECTION

A joint dinner meeting of the Section and the Western Society of Engineers took place on March 16, with the ladies of the two groups present as guests. After-dinner entertainment consisted of a talk on life in South America, presented by Mason Warner. Mr. Warner, who is a foreign correspondent and radio lecturer, described his travels in Peru, Bolivia, and Brazil, supplementing his talk with beautiful, colored films.

LOS ANGELES SECTION

Over a hundred members of the Associated General Contractors were guests of the Section at its March 10th dinner meeting. The principal speaker was Harold W. Richardson, Western editor of *Engineering News-Record*, who gave a graphic account of the construction of the Alcan Highway, illustrating his remarks with slides depicting the process of construction. A talk on the necessity of buying war bonds—by Alden Price, representing the Treasury Department—concluded the program.

LOUISIANA SECTION

At the annual meeting of the Section—held in New Orleans on February 6—the following officers were elected for the coming year: A. M. Fromherz, president; David W. Godat, first vice-president; C. G. Cappel, second vice-president; and E. L. Mire, secretary-treasurer. The guest speaker of the evening was Robert W. Elsasser, vice-president and general manager of the Pendleton Shipyards Company, Inc. His talk was entitled "Administrative Thinking." Capt. C. W. Scaling, of the U.S. Marine Corps, also spoke briefly, making an appeal for the enlistment of qualified officers in the Marine Corps and stating that the need for engineers is especially great.

MARYLAND SECTION

A symposium on wood construction was the feature of the March meeting of the Section. Those taking part were J. H. Carr, Jr., structural engineer for the Timber Engineering Company, Washington, D.C., who traced the history of timber connectors; Verne L. Ketchum, chief engineer of Timber Structures, Inc., New York, N.Y., who spoke on the design and fabrication of glued laminated structures; and R. P. A. Johnson, wood consultant for the conservation division of the War Production Board, who discussed the use of lumber as a substitute material. All the talks were illustrated by slides.

METROPOLITAN SECTION

"Construction of an Off-Continent Defense Base" was discussed at the March meeting, the principal speaker being William Beattie, chief engineer of Bermuda Base Contractors. Transportation difficulties were responsible for problems in housing, Mr. Beattie stated, as many of the materials of construction had to be taken to the base. He also discussed developments in concrete construction, stating that coral rock and brackish water were used for mixing—fresh water was scarce and had to be conserved. Roads were surfaced with an emulsified asphalt mix, but by constructing an asphalt plant on the base and shipping only the refined asphalt the contractors were able to save over 45% of the shipping space required for emulsified asphalt. Two moving pictures, furnished by the British Information Service, concluded the program.

MID-MISSOURI SECTION

On March 26 members of the Section went to Rolla for their spring meeting with the Missouri School of Mines Student Chapter. Other guests included Student Chapter officers from the University of Missouri and the ladies of the Section. Following dinner, George S. Russell, president of Russell and Axon, spoke on the subject, "Time is of the Essence." Mr. Russell stressed the importance of time in engineering war contracts during the present emergency, illustrating his talk with examples from his own consulting experience.

OREGON SECTION

The speaker at the February meeting was Paul M. Dunn, dean of the School of Forestry at Oregon State College, who discussed the research programs being carried out at the Forest Products Laboratory, with particular reference to recent developments of interest to the Pacific Northwest. There was a large turnout for the March meeting—a joint session with the Portland chapter of the Associated General Contractors. An illustrated lecture on the construction of the Alcan Highway comprised the technical program. This was given by Harold W. Richardson, Western editor of *Engineering News-Record*.

PHILADELPHIA SECTION

On March 9 there was a good turnout to hear A. J. Boase, manager of the Structural and Technical Bureau of the Portland Cement Association, discuss the subject of "Reinforced Concrete in the Present Effort." Mr. Boase stated that for the first time in our history we are faced with the necessity of conserving certain critical materials, notably steel. "It is the natural reaction for engineers to want to increase the working stresses of the materials when greater economy of structure is desired," he said. However, this increase does not necessarily make for economy, nor does it mean the greatest saving of material. No appreciable saving can be made by merely increasing the allowable fiber stresses without a corresponding reduction in the factor of safety. He pointed out that the same result could be obtained by eliminating the unusable excess strength obtained by conventional design. Mr. Boase concluded his talk by showing a series of slides of various construction projects, depicting unusual applications of reinforced concrete.

ROCHESTER SECTION

The Rochester Section held two meetings in March. At the first of these Maj. Ira D. S. Kelly, of the Corps of Engineers, U.S. Army, discussed wartime construction projects, including Fort Leavenworth, Fort Riley, and the Kodak Optical Works. Major Kelly gave a detailed discussion of the latter project, on which he has been serving as area engineer. His talk was interestingly illustrated. On the 25th there was a joint meeting with the Rochester Engineering Society, the speaker being Lt. John T. Casey, public relations officer for the U.S. Naval Training Station at Sampson, N.Y. Lieutenant Casey's subject was "The New Navy."

SACRAMENTO SECTION

Of the five meetings held in March, only one was addressed by a member of the Society—that of March 23 when Harold W. Richardson, Western editor of *Engineering News-Record*, gave a dynamic illustrated account of the Alcan Highway. The record-breaking audience, a tribute to both the speaker and his subject, saw first hand the problems and the answers of this epic construction project. Subjects discussed at the other meetings were "Soil and Victory Gardens"; Central Valley Project Socio-Economic Studies"; "State Personnel Problems During Wartime"; and "Strategic Minerals in California."

ST. LOUIS SECTION

There was an unusually large attendance at the regular luncheon meeting—on March 22—to hear E. J. Critzas speak on prestressed concrete. Mr. Critzas, who is construction engineer for the Borsari Tank Corporation of America, explained why early experiments in prestressing concrete with ordinary steels were unsuccessful and how the proper use of steel wires of high tensile strength

JOINT MEETING OF THE MID-MISSOURI SECTION AND THE MISSOURI SCHOOL OF MINES CHAPTER

gives almost phenomenal results. He exhibited and explained the details of a reinforcing assembly in which the wires were stressed to 125,000 lb per sq in and which was developed for prestressing structural concrete on the job in ordinary forms, instead of precasting individual members. On March 25 there was a joint meeting with the Engineers' Club of St. Louis. The speaker on this occasion was Thomas J. Skinker, water commissioner of St. Louis, who presented a paper on "Problems of Growth of the St. Louis Water Division."

San Diego Section

An unusually interesting program had been arranged for the February meeting of the Section. First, K. M. Walker, marine surveyor, related many interesting anecdotes from his seafaring experiences, which have included the salvaging of numerous ships and their cargoes. Then Lt. Comdr. Hess, who is recovering from wounds received in battle during the sinking of an aircraft carrier in the Pacific, gave an interesting account of his experiences in action.

Seattle Section

The new officers for the Seattle Section are Richard Ellis, president; A. L. Miller, vice-president; and M. S. Campbell, secretary-treasurer. They were elected at the February meeting of the Section. Talks on soil cement comprised the technical program at this session, the speakers being Bailey Tremper and W. Allen Grubb. Mr. Tremper, who is materials and testing engineer for the Washington State Highway Department at Olympia, gave the history, theory, and design requirements of soil cement, while Mr. Grubb described some of the practical uses of the product. The latter is district engineer for the Portland Cement Association.

Tacoma Section

At the February meeting of the Section Charles E. Andrew, chief consulting engineer for the Washington Toll Bridge Authority, discussed the demolition work on the old Tacoma Narrows Bridge as well as some phases of design for the proposed new structure. Motion pictures showing the research work being carried on by the Toll Bridge Authority through model studies at the University of Washington supplemented his talk. The speaker at the March dinner meeting was E. L. Warner, former president of the Section. Mr. Warner's subject was "Our Unarmed Conflict," in which he dealt with post-war problems facing the world.

Tennessee Valley Section

The Section reports meetings of both the Knoxville and Chattanooga Sub-Sections on March 9. The speaker at the former session was R. W. Stuck, chief engineer of the engineering division of the South Atlantic Division of the Corps of Engineers, who described his experiences in Russia ten years ago. The latter group met with local sections of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers, the Chattanooga Sub-Section acting as sponsor. On this occasion the speaker was Col. Duncan Richart, commanding officer at Fort Oglethorpe, whose subject was "The Military Engineer in War." The Asheville Sub-Section celebrated Ladies' Night with the Engineers' Club of Western North Carolina on March 15. A program was presented by the International Printing Ink Company. Members of the Muscle Shoals Sub-Section met with representatives of the other Founder Societies on March 12 to formulate a plan for joint meetings.

West Virginia Section

A dinner meeting of the Section was held in Wheeling on April 2. An interesting program had been arranged by W. O. McCluskey, Jr., vice-president of the Section. First, John R. Morrill, assistant to the vice-president of the Lincoln Electric Company, presented an illustrated lecture entitled "Arc Welding Developments in the Structural Field." In his talk Mr. Morrill pointed out that the use of arc welding for the fabrication of bridges, factories, and other structures is just becoming fully recognized, despite its many years of use as an industrial tool. Then R. O. Bowman, engineer for the Koppers Company, spoke on the subject of "Miracle Coal," placing great emphasis upon the value of coal as a chemical from which astonishing by-products have been and will be developed.

Appointments of Society Representatives

WILLIAM N. CAREY, M. Am. Soc. C.E., has been appointed the Society's representative on the Highway Research Board of the Division of Engineering and Industrial Research of the National Research Council, to fill the vacancy caused by the death of COL. C. E. MYERS, M. Am. Soc. C.E.

WILLIAM H. CHORLTON and LAURENCE B. MANLEY, Members Am. Soc. C.E., represented the Society at the annual meeting of the American Academy of Political and Social Science, which was held in Philadelphia on April 9 and 10.

HAROLD M. LEWIS (chairman), HARLAND BARTHOLOMEW, and C. A. FARWELL, Members Am. Soc. C.E., have been appointed to represent the Society on a proposed Joint National Committee of the American Planning and Civic Association.

A. C. POLK, M. Am. Soc. C.E., chairman; FREDERICK H. FOWLER, Past-President Am. Soc. C.E.; and CLARENCE M. BLAIR, SAMUEL A. GREELEY, E. N. HUNTING, and GUSTAV J. REQUARDT, Members Am. Soc. C.E., have been reappointed members of the so-called Washington Committee.

Student Chapter Notes

College of the City of New York

Winter activities of the College of the City of New York Chapter included talks by Dr. Mario Salvadori, instructor in civil engineering at Columbia University, and J. Charles Rathbun, professor of civil engineering at City College. Mr. Salvadori discussed the theoretical problems that yield to the method of photoelasticity. By means of actually running several tests the method of demonstrating lines of equal stress by observation of the color pattern was clearly shown. Professor Rathbun's subject was the esthetics of bridge design, and he illustrated his subject with views of bridges in many remote parts of the world. Among the more recent speakers were D. B. Steinman, New York City consultant, who discussed the failure of the Tacoma Narrows Bridge; F. C. Rogers, of the Portland Cement Association, whose subject was "Modern Design of Reinforced Concrete Structures"; and Woodman F. Scantlebury, an engineer for the Republic Aviation Corporation, who spoke on aircraft design.

Georgia School of Technology

At the Honor Day exercises at the Georgia School of Technology, the Georgia Section's prizes of Junior membership in the Society were presented to C. A. McLeod and J. E. Stephanson. The William A. Hansell Prize, consisting of Junior membership in the Society and a pin, went to F. W. Rose, Jr., former president of the Student Chapter. Presentations were made by Paul Weir, former chairman of the Section's Committee on Student Chapter Activities. This is the first year that the awards have been made at the Honor Day exercises, and the occasion was acclaimed an enjoyable one.

University of Tennessee

The University of Tennessee Student Chapter reports a number of interesting activities. On one occasion there was a special meeting addressed by Howard J. Hansen, associate professor of engineering at Texas Agricultural and Mechanical College. Professor Hansen, who was en route home from the Annual Meeting in New York where he had delivered a paper on timber engineering, presented the same paper to the group. There was a large attendance of about 125. On another occasion members of the Chapter visited Douglas Dam, which is now in the process of construction. By special courtesy of the Tennessee Valley Authority, the students were permitted to view many interesting features of the work, including turbine installations.

Through an inadvertence the annual report of the Chapter for the 1941–1942 school year was omitted from CIVIL ENGINEERING.

ITEMS OF INTEREST

About Engineers and Engineering

Society Members Honored by Franklin Institute

Two members of the Society—Charles M. Allen and Anders H. Bull—were among those honored by the Franklin Institute at its Medal Day Exercises, which were held in Philadelphia on April 21. Professor Allen, of Worcester Polytechnic Institute, received the Elliot Cresson Medal in recognition of his "inspired contribution to the field of hydraulics."

Much of Professor Allen's career has been devoted to the conduct of efficiency tests of water wheels. The particular achievement for which he received the Cresson Medal was the development of the salt velocity method of measuring the flow of water, which has become one of the standard methods of measuring large rates of flow.

At the same ceremony Mr. Bull was awarded the Louis Edward Levy Medal for the best paper published in the Journal of the Institute in 1942. His paper, entitled "Soil Pressure Distribution Along Flexible Foundations," was cited "an outstanding contribution to the literature of foundation engineering." Mr. Bull is an engineer for the New York City Board of Transportation.

Army and Navy "E" Award to Engineers

THE January issue listed contractors awarded the Army and Navy "E" for outstanding performance of contracts. To this list may now be added the names of certain engineering firms that have been thus honored for design and construction. On April 17, Whitman, Requardt and Smith received the award for their professional services on the Rocky Mountain Arsenal Construction Project. Similarly, the firm of Fred Howland, Inc., is being honored for its work on the Florida Army Air Base, and the firm of Sanderson and Porter has also received the award.

It is believed that these are among the first engineering firms to receive the Army and Navy "E" for their professional services. The reason for this is the fact that the Army and Navy "E" is considered primarily a production award.

Enlistments in Corps of Engineers Invited

UNDER a program recently announced by Maj. Gen. Eugene Reybold, Chief of Engineers, trained equipment operators who have been working as civilians on engineering and construction projects may, prior to their induction by Selective Service, volunteer for enlistment in the Corps of Engineers. The nearest Army Engineer Office will take their applications, pass on their qualifications, and provide them with a letter to their Induction Station, which will earmark them for duty with the Engineers. Candidates will then be sent to training centers at Fort Belvoir, Va.; Fort Leonard Wood and Jefferson Barracks, Mo.; or Camp Claiborne, La.

Candidates will have the same opportunity to secure commissions through the Engineer Officer Candidate School as other enlisted men, but their previous training should allow them to speed up the normal process. The plan goes into effect immediately, and Engineer officers hope to recruit 9,000 specialists a month.

Highway Conference at University of Tennessee

WAR and post-war highway problems will be discussed at the Annual Highway Conference, to be held at the University of Tennessee on May 14 and 15. A number of outstanding speakers in the highway field have been secured for the two-day technical program. These include Walter Brooks, D. M. Moulton, and A. P. Connell, of the Tennessee State Highway Department; P. J. Freeman and Everett Scroggie, of the Tennessee Valley Authority; Prof. E. S. Fabian, of the University of Tennessee; Prof. R. A. Moyer, of Iowa State College; M. D. Catton, manager of the Soil Cement Bureau of the Portland Cement Association; and John W. Poulter, of the Koehring Company.

The conference has been arranged by the civil engineering department of the University of Tennessee, with the cooperation of the TVA and the Tennessee State Highway Department.

N. G. Neare's Column

Conducted by

R. ROBINSON ROWE, M. AM. SOC. C.E.

"UNRATIONED recaps haven't lessened our consciousness of rubber problems," ventured Professor Neare. "I'd feel a lot more secure standing before this Engineers Club if I could trade my guayule suspenders for a pair of Para caoutchouc. So tonite we come to the finale of Count de Myles' tire problem, with added interest because of the failure of the OPA to set a ceiling on services.

"The Count, you remember, planned to realize the most from his tires by using his spare successively on his left rear, right front, and left front wheels. At 25 cents per wheel jacked, plus 10 cents for handling the spare, the three shifts cost him 35 + 60 + 60 cents, for the second shift meant taking the spare from the left rear to the right front, storing the right front for a spare and replacing the original left rear tire. Is there a cheaper way?"

"Cheap enuf for me," said Mack McMaque. "I drove in for free air yesterday and was taxed $2.00 for tire examinations plus 40 cents for new valves. Where is this 5-10-25 cent garage?"

"Probably in the Professor's wild imagination. However," Cal Klater continued, "it made a nice problem. If the Count's garage stays in business, the three shifts can be done for 35 cents each, saving 50 cents in all. After 3,828 miles he should put his spare on the left front wheel. Then at $7{,}746^{17}/_{19}$ miles the original left front tire should be taken from the spare rack to the right front wheel. Finally, at 10,000 miles the original right front tire should go on the left rear, so that four tires are spent at 10,821 miles, as before."

"An excellent plan," agreed the Professor. "It may be of academic interest to mention another, the instant spare being moved to the right front, left front, and left rear wheels in that order at $5{,}668^{8}/_{19}$, $6{,}299^{8}/_{14}$ and 10,000 miles, respectively. Assuming the order of the changes, ten simple equations in ten unknowns can be solved for the mileages of each tire on each wheel. Of the six possible orders, the other four yield negative mileages.

"Our next problem involves the logistics and strategy of winning without getting the mostest there fustest but having the bestest last longestest.

"In a showdown day-in-day-out fight between two *air*madas, each jap pilot brot down a Yank pilot, on the average, once in 40 days, but each Yank pilot scored, on the average, once in 10 days.

"Despite individual superiority, the outnumbered Yanks faced extermination. Their commander found the answer in the racial difference, 'A down jap is out; a Yank may be down but he's never out!' Nurses, mechanics, and parachutes made it possible to put half his downed pilots back in action, on the average, three days after bailing out, so he won the showdown.

"If the original Yank strength was 1,000 planes and pilots, between what limits was the jap strength?"

[Only Richard Jenney rated the Cal Klater award this month. He reported an engineering lull, with half the office working N. G. Neare problems and the other fellow cutting out paper dolls.]

NEWS OF ENGINEERS

Personal Items About Society Members

WALLACE B. BOGGS, civil and consulting engineer of Oakland, Calif., has been appointed Alameda County surveyor.

GEORGE E. OWENS is now a captain in the Corps of Engineers, U.S. Army. He was formerly chief engineer for the Massman Construction Company in Kansas City, Mo.

GEORGE W. SVOBODA, major, Corps of Engineers, U.S. Army, has been made area engineer of the Columbia (S.C.) area. Until lately Major Svoboda was area engineer at Shaw Field.

HAROLD J. A. CHAMBERS, for the past three years chief engineer of the Hamilton Bridge Company, Ltd., at Hamilton, Ontario, was recently appointed general manager of the firm.

CHARLES H. BARTH, JR., colonel, Corps of Engineers, U.S. Army, has been promoted to the rank of brigadier general and made Chief of Staff of American forces in the European theater. General Barth was previously Chief of Staff of the U.S. Army forces in the Middle East.

ROY G. HARLEY, an ensign in the Construction Battalions of the Navy, is now in Chicago in the Recruiting Service. Prior to receiving his commission Mr. Harley was assistant engineer for the American Steel and Wire Company in Cleveland.

M. G. SPANGLER and J. P. LAWLOR, respectively, research associate professor of civil engineering and assistant professor of sanitary engineering at Iowa State College, have been made lieutenant commanders in the Construction Battalions of the U.S. Navy. Both are in training at Williamsburg, Va.

HARVEY L. VINCENT, construction superintendent for the Lummus Company, has been transferred from the construction of the Maumelle Ordnance Works in Arkansas, to other work for the same company at Huntington and Charleston, W.Va.

HAROLD D. CAVIN has been granted a leave of absence from his duties as resident engineer for the Puget Sound Pulp and Timber Company at Bellingham, Wash., in order to join the Construction Battalions of the U.S. Navy. He has the rank of lieutenant commander and, at present, is in training at Williamsburg, Va.

HAROLD B. BURSLEY will continue as managing associate of E. S. Draper Associates, landscape architects and town planners of Charlotte, N.C., while serving the recently appointed Planning Commission of Asheboro, N.C., in preparing a zoning and thoroughfare plan for the city.

W. W. ZASS has been promoted from the rank of major in the Corps of Engineers, U.S. Army, to that of lieutenant colonel. He is engaged in surveying and construction work on the 500-mile stretch of the Inter-American Highway in Honduras, Nicaragua, and El Salvador.

BEVERLY C. DUNN is now a brigadier general in the Corps of Engineers, U.S. Army, this rank representing a recent promotion from that of oolonel.

L. B. FEAGIN has been promoted from the rank of lieutenant colonel in the Corps of Engineers, U.S. Army, to that of colonel. Announcement of the promotion reached Colonel Feagin while he was attending the Local Sections Conference at the Dallas Meeting on April 7, in his capacity as president of the St. Louis Section. He is district engineer for the U S. Engineer Office at St. Louis, Mo.

JOHN S. MACDONALD is general manager and vice-president of Walsh-Kaiser Company, Inc., a new organization from the Walsh Construction Company and the Kaiser interests that has taken over the Fields Point shipyard at Providence, R.I. Formerly Mr. Macdonald was chief engineer for the Walsh Construction Company at Long Island City, N.Y. Another member of the Society—EDGAR F. KAISER, resident vice-president and job manager for Consolidated Builders, Inc., at Mason City, Wash.—is also vice-president.

DANIEL NOCE, brigadier general, Corps of Engineers, U.S. Army, was awarded a Distinguished Service Medal for his work in organizing the Army's amphibian engineers at ceremonies held at Fort Devens, Mass., on February 16. The citation read, in part, as follows: "his leadership and inspiration have contributed in a marked degree toward the readiness of the army to carry out worldwide offensive missions."

CHILTON W. MCLAUGHLIN, JR., of Kansas City, Kans., has been commissioned a lieutenant (jg) in the Construction Battalions of the Navy.

GEORGE V. T. BURGESS has been admitted to partnership in the consulting engineering firm of Coverdale and Colpitts, New York. Mr. Burgess has been senior engineer for the organization since 1941.

JUNIUS R. GARDNER is now a captain in the Sanitary Corps, 30th Medical Training Battalion, and is stationed at Camp Grant, Ill. Prior to being commissioned he was chief designing engineer for Warren and Van Praag, Inc., consulting engineers of Decatur, Ill.

S. S. STEINBERG, dean of the college of engineering of the University of Maryland, has been appointed regional representative of the Bureau of Training of the War Manpower Commission. He is to serve as adviser for all scientific and engineering training on the college level in the District of Columbia, Maryland, Virginia, West Virginia, and North Carolina.

ARTHUR R. HOLLETT was recently commissioned a captain in the Corps of Engineers, U.S. Army, and assigned to duty in Brazil. Prior to being commissioned he was university engineer and supervisor of physical plant at the University of North Carolina.

HARRY A. SWANSON is now assistant professor of civil engineering at North Dakota Agricultural College.

JOHN D. MENDENHALL, of the Bechtel-McCone-Parsons Corporation, Aircraft Division, has been transferred from Los Angeles to Birmingham, Ala., where he is in charge of structural and civil engineering.

CROSBY MILLER was recently promoted from the position of bridge engineer for the Chesapeake and Ohio Railway to that of assistant chief engineer. His headquarters are in Richmond, Va.

WARNER HARWOOD, formerly engineer of the Highways and Municipal Bureau of the Portland Cement Association, has been appointed regional highway engineer for the organization for territory comprising nine Western states.

C. F. SEIFRIED has been made superintendent of the Wyoming State Highway Department. In addition, he will continue as chief engineer.

FRANCIS M. DAVIS has severed his connection with the Texas State Highway Department—he was assistant district engineer at Paris—in order to take up active duty with the Navy. He is now in training at Norfolk, Va.

JOHN C. GEARHART is now an ensign in the Civil Engineering Corps of the U.S. Navy, assigned to the "Sea Bees." Mr. Gearhart was, until lately, assistant engineer with Stevens and Koon, consulting engineers of Portland, Ore.

WILBUR BARROWS, previously associate structural engineer for the Tennessee Valley Authority at Knoxville, Tenn., has been commissioned a lieutenant (jg) in the Civil Engineering Corps of the U.S. Navy. At present he is stationed at Williamsburg, Va. Other members of the TVA staff now on active duty include JAMES D. FLAGG, lieutenant, U.S. Marine Corps, New River, N.C.; LESTER G. HIGH, ensign, U.S. Navy, at the Fighter Director School, Pearl Harbor, Hawaii; CHARLES M. HOLBROOK, ensign, U.S. Navy, at the U.S. Naval Academy at Annapolis, Md.; and JAMES R. GENTRY, chief petty officer in the "Sea Bees," stationed at Norfolk.

DECEASED

EDWIN PARK ARNESON (Jun. '40) of San Antonio, Tex., died on January 1, 1943, at the age of 25. Following his graduation from the Texas Agricultural and Mechanical College in 1938, Mr. Arneson became connected with the Texas State Highway Department. Later he was with Pan-American Airways, Inc., at Brownsville, Tex. At the time of his death he was in the U.S. Army. Mr. Arneson's father was the late Edwin Percival Arneson, M. Am. Soc. C.E., who died on December 7, 1938, while serving a term as Director.

CHARLES BARNES CARTWRIGHT (Assoc. M. '27) right of way engineer for the Wayne County Road Commission, Detroit, Mich., died on February 25, 1943, at the age of 47. Mr. Cartwright had been with the Michigan Road Commission since 1920, having been resident engineer, construction superintendent, and right of way engineer. During the first World War he served as a second lieutenant with the 605th Engineers in France.

JOHN WARREN CHILDS (M. '31) since 1930 deputy commissioner of the New Hampshire State Highway Department, Concord, N.H., died on September 23, 1942, though word of his death has just reached the Society. Mr. Childs, who was 54, was with the New Hampshire State Highway Department from 1916 to 1920 and from 1923 on, having been office engineer, division engineer, bridge engineer, and deputy commissioner. Earlier in his career (1912 to 1916) he was with the

U.S. Reclamation Service (now the Bureau of Reclamation).

PAUL DARWIN COOK (M. '16) civil engineer of Sioux City, Iowa, died recently at the age of 59. Early in his career Mr. Cook was engaged in railroad work. From 1913 to 1923, except for a period of war service, he maintained a consulting practice, and from 1924 to 1932 was chief engineer for Favrot and Livaudais, Ltd., of New Orleans, La. From 1932 to 1934 and, again, from 1936 to 1938 he was city engineer of Sioux City. During the war Mr. Cook served in the Corps of Engineers, U.S. Army, having the rank of major.

LESLIE HAROLD DODD (Assoc. M. '22) since 1935 district engineer for the American Institute of Steel Construction, Inc., at St. Louis, Mo., died on March 14, 1943. Mr. Dodd, who was 54, had served as district engineer for the Institute at Dallas, Tex., from 1929 to 1932. Earlier he had maintained consulting practices in Lawrence and Topeka, Kans., and Kansas City, Mo. He had been in charge of the design and construction of the reinforced concrete stadium at the University of Kansas, and during the first World War served in the U.S. Army.

WILLIAM OTTO GALBREATH (M. '30) of Kansas City, Mo., died on March 14, 1943, at the age of 71. For a number of years Mr. Galbreath had been with the U.S. Department of Agriculture, and at the time of his retirement in 1942 was field assistant in charge of the Kansas City office of the valuation department. Earlier in his career (1907 to 1912) he was division engineer for the Mexican National Railway and later was connected with railroads in this country—the Chicago Great Western, the Kansas City Southern, and the Missouri Pacific.

JOHN BYRON GOLDSBOROUGH (Affiliate '99) chairman of the board of the Underpinning and Foundation Company, New York City, died on March 26, 1943, as the result of a fall. He was 79. Mr. Goldsborough directed the construction of subways and other projects necessitating the use of compressed air—a technique he was largely responsible for developing. For a number of years he was general manager of the Jules Breuchard Construction Company in New York, and later founded the Underpinning and Foundation Company. The projects on which he was engaged included the Croton Dam and aqueduct; the Ashokan Dam and watershed; parts of the New York and Philadelphia subways; and a section of the Lincoln Tunnel.

ANDREW H. HARKNESS (M. '19) consulting engineer of Toronto, Canada, died suddenly at his home in that city on February 28, 1943. Mr. Harkness, who was 70, was for a number of years senior member of the consulting firm of Harkness and Hertzberg. In this capacity he was responsible for the structural work on many of the leading buildings in Canada. In 1935 he received the Sir John Kennedy Medal of the Engineering Institute of Canada for "outstanding merit in his profession."

JERE CHAMBERLAIN HUTCHINS (M. '00) pioneer developer of a web of interurban electrical lines, died at his home in Grosse Pointe, Mich., on February 24, 1943. He was 91. Mr. Hutchins went to Detroit in 1894 as vice-president of the Citizens Railway Company. Later he became vice-president, general manager, and treasurer of the newly organized Detroit United Railway, and in time was made president. Since his resignation from the latter position in 1916 Mr. Hutchins has been regarded as the dean of Detroit's baseball enthusiasts.

CHARLES LINCOLN KELLER (M. '05) consulting engineer of Chicago, Ill., died at a hospital in Dixon, Ill., on March 4, 1943. Had Mr. Keller lived a few days longer he would have been 72. For many years he was president of the Scherzer Rolling Lift Bridge Company in Chicago, and more recently a member of the consulting firm, Keller and Harrington. As such Mr. Keller designed railroad bridges in the United States, Europe, and India, and worked on the design for the Van Buren Street elevated bridge—the first double-deck movable structure built in Chicago.

HALLETT EDWARD MCCLINTOCK (M. '19) valuation engineer for the U.S. Department of Agriculture at Kansas City, Mo., died on February 22, 1943. He was 60. From 1909 to 1917 and, again, from 1925 to 1928 Mr. McClintock was with the Union Pacific Railroad at Omaha, Nebr. From 1917 to 1919 he served overseas with the Corps of Engineers, having the rank of captain; from 1919 to 1920 he was assistant engineer for the city of Omaha; and from 1921 to 1925 he was in private practice. He had been valuation engineer for the U.S. Department of Agriculture since 1929.

JOHN A. NEWLIN (M. '24) for many years chief of the division of timber mechanics at the U.S. Forest Products Laboratory, Madison, Wis., died on March 27, 1943. Mr. Newlin, who was 71, was considered an outstanding authority on the use of wood as an engineering material. In 1904 he joined the U.S. Forest Service as engineer in timber testing on a cooperative project then under way with Purdue University. A short time later he was placed in full charge of this work, which was shifted to Madison in 1910 with the establishment of the Forest Products Laboratory there. About a month ago Mr. Newlin retired.

PERCIVAL ROBERTS, JR. (M. '84) retired executive of Ardmore, Pa., died there recently. Mr. Roberts, who was about 85, had been president of the A. & P. Roberts Company and of the American Bridge Company. He was also a director of the Pennsylvania Railroad Company. Earlier in his career (1876 to 1900) he was with the Pencoyd Iron Works. Long a member of the Society, Mr. Roberts served as Director from 1910 to 1912.

ARTHUR LELAND RICHARDSON (Assoc. M. '29) civil engineer of Yamhill, Ore., died at his farm near Yamhill on March 11, 1943, at the age of 64. From 1924 until recently Mr. Richardson was in the Bridge Department of the California division of Highways, having been assistant construction engineer and construction engineer. Earlier (1915 to 1924) he was chief draftsman and assistant engineer in the maintenance of way department of the Southern Pacific Company, and before that had been in private practice.

LEONARD CHARLES LINDSAY SMITH (M. '01) consulting engineer of Flushing, N.Y., died recently. For many years Mr. Smith maintained a consulting practice in Long Island City, N.Y. Earlier in his career he had been assistant engineer for the Department of Water Supply, Gas, and Electricity at Long Island City.

EDGAR KENNETH SMOOT (M. '98) engineer of railway and harbor works in Mexico City, died at his home there on February 19, 1943. Mr. Smoot, who was 81, had been engaged in railroad work in Texas and, at one time, was city engineer of Dallas. In 1891 he formed the engineering and construction firm of O'Connor and Smoot, contracting and building the jetties at Galveston. Later, in an individual capacity, he built harbors for the government of Mexico at Manzanillo, Yavaros, Frontera, Mazatlan, and Salina Cruz. He was also president and operator of the Rio Maro Railroad in the state of Sonora.

WILLIAM SHERMAN VAN LOAN (Assoc. M. '31) since 1927 supervisor of construction and maintenance for the Buffalo (N.Y.) Board of Education, died recently. He was 64. From 1910 to 1917 and, again, from 1919 to 1924 Mr. Van Loan was construction engineer for the Supervising Architect of the Treasury Department, Washington, D.C., in charge of construction and repair of public buildings. From 1924 to 1927 he was office manager for Frank A. Spangenberg, Buffalo (N.Y.) architect. During the first World War he served overseas with the 7th U.S. Engineer Regiment, having the rank of captain.

GUY SMITH WOOD (Assoc. M. '24) manager of the Herkimer Division of the International Paper Company, Herkimer, N.Y., died on January 30, 1943. Mr. Wood, who was 54, had been with the International Paper Company since 1919, having been resident engineer for the organization in New York for some years. Earlier in his career he had been with the New York State Public Service Commission; the Interborough Rapid Transit Company; and Ford, Bacon, and Davis.

EDWARD LOWREY WOODRUFF (M. '00) retired engineer of Flushing, N.Y., died on April 1, 1943, at the age of 91. Mr. Woodruff spent his entire career in the U.S. Lighthouse Service, which he entered in 1872. From 1910 to 1912 he was superintendent of the 18th Lighthouse District in California, and from the latter year to 1914 superintendent in charge of the 11th Lighthouse District at Detroit. He was responsible for the design of lighthouse structures on the Atlantic and Pacific coasts and the Great Lakes. During the first World War Mr. Woodruff served in the U.S. Navy.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From March 10 to April 9, 1943, Inclusive

Additions to Membership

ANDREWS, HAROLD JOSEPH (Jun. '43), Research Structural Engr., Aluminum Research Laboratory, Aluminum Co. of America, Box 772 (Res., 910 North St.), New Kensington, Pa.

ARISON, SOLOMON BENJAMIN (Assoc. M. '43), Civ. Engr. (Water Supply), Board of Water Supply, 120 Wall St., New York, N.Y.

ATTRIDGE, WILLIAM JAMES (Assoc. M. '43), Asst. Engr., U.S. Bureau of Reclamation, Redding, Calif.

BARBER, THOMAS WOODROW (Jun. '42), Ensign, U.S.N.R., Box 608 Twin Falls, Idaho.

BERRY, JAMES WATKINS (Assoc. M. '43), Associate Engr., U.S. Engr. Office, Custom House, Nashville, Tenn.

BRANIGAN, GEORGE FRANCIS (Assoc. M. '43), Associate Prof., Gen. Eng.; Head, Mech. Drawing, Bradley Polytechnic Inst., Peoria, Ill.

BROOKS, WILLIAM ALEXANDER (Jun. '42), Ensign, U.S.N.R., 50 Renner Ave., Newark, N.J.

BRUNS, ROBERT BRUCE (Jun. '42), Ensign, U.S.N., 88-43 One Hundred and Ninety-Second St., Hollis, N.Y.

BURMEISTER, SUMNER FRED (Jun. '42), Civ. Engr., Douglas Aircraft Corp., El Segundo (Res., 409 Edgewood St., Inglewood), Calif.

CASHIN, JOHN THOMAS (Assoc. M. '43), Civ. Engr., Hunkin-Conkey Constr. Co., 1740 East 12th St., Cleveland (Res., 23112 Virginia Ave., North Olmsted), Ohio.

CHRISTINSON, KENNETH MARIUS (Jun. '43), Associate Engr., U.S. Army Engrs., 8010 North West St. Helens Rd., Portland, Ore.

CLARK, BRADFORD NORMAN (Assoc. M. '43), Senior Engr. (San.), U.S. Engr. Office, 120 Wall St., New York, N.Y. (Res., 1822 Lamberts Mill Rd., Westfield, N.J.)

CROCHERON, JOHN LOGAN (Jun. '42), 2d Lt., Air Corps, U.S. Army, Maintenance Eng. Officer, Bruneau, Idaho.

DIGIGLIO, VITO ANTHONY (Jun. '43), Junior Welding Engr., Naval Gun Factory, Navy Yard (Res., 1426 Twenty-First St., N.W.), Washington, D.C.

FLEMING, CLIFFORD NEAL (Jun. '42), Res. Officer in Chg., Constr., U.S.N., Auxiliary Air Station, Camp Kearney (Res., 8045 Girard St., La Jolla), Calif.

FORZLEY, VICTOR GEORGE (Jun. '43), Structural Engr., Chas. T. Main Co., Inc., Boston (Res., 88 Locust Ave., Worcester), Mass.

FROHOCK, FRED CLIFTON (Assoc. M. '43), Asst. Public Works Planning Supt., U.S.N., Naval Station (Res., 3070 Harris Ave.), Key West, Fla.

GERLACH, NORMAN WILLIAM (Jun. '42), Aviation Cadet, Air Force, U.S. Army, Route 1, Box 257, Tigard, Ore.

GLAZER, IRVING HAROLD (Jun. '42), Ensign, U.S.N.R., 71 Fairfield Ave., South Norfolk, Conn.

GOODMAN, WILLIAM WARD (Assoc. M. '43), Architectural Designer (Structural), Sanderson & Porter, Pine Bluff Arsenal (Res., 5905 North Country Club Blvd.), Little Rock, Ark.

GRANT, WALTER SCHUYLER, JR. (Assoc. M. '43), Maj., Field Artillery, U.S. Army, Headquarters, 32d Battalion, 8th Regiment, FARTC, Fort Sill, Okla.

GRANTHAM, GEORGE RICHARD (Jun. '43), 1st Lt., San. Corps, U.S. Army, 138 Burcham Drive, East Lansing, Mich.

HAULENBEEK, GARRIE BEAZLEY (Jun. '42), Supt., Constr. Service Co., Inc., 333 North Broad St., Elizabeth, N.J.

HAWLEY, JOHN ARMITAGE (Jun. '42), 646 West 30th St., Indianapolis, Ind.

HENDERSON, ROBERT DAWSON (Jun. '42), Corporal, Air Force, U.S. Army, 1353 West French Pl., San Antonio, Tex.

HENRY, WILLIAM LEDBETTER (Jun. '42), Engr., Chicago Bridge & Iron Co., 1500 North 50th St. (Res., 600 South 53d St.), Birmingham, Ala.

HEYMANN, CURT JOSEPH (Assoc. M. '42), P. O. Umgeni Dam, via Maritzburg, South Africa.

HIGMAN, RALPH KREION (Jun. '42), Junior Engr., War Constr. Div., E. I. du Pont de Nemours, Inc., Wabash River Ordnance Works, Rockville, Ind.

HOWE, ODIA E., JR. (Jun. '42), With U.S.M.C.R., 1533 Oxford, Berkeley, Calif.

HUTCHINS, BION SHEPARD, JR. (Assoc. M. '43), Senior Engr., Design Dept., State Highway Comm., Masonic Temple (Res., 2341 Ohio St.), Topeka, Kans.

JENNINGS, HUBERT ERNEST (Jun. '43), Lt., U.S.N., 330 Rhode Island Ave., N.E., Washington, D.C.

KING, DAVID HERMAN (Jun. '42), Instr., Gen. Eng. Dept., Iowa State College, Ames (Res., 226 East 4th St., Spencer), Iowa.

LAMMIMAN, GORDON FREDERIC (Jun. '42), Ensign, CEC-V (S), U.S.N.R., 276 Coventry Rd., Berkeley, Calif.

LARSON, EWALD CLAUS (Jun. '43), Asst. Engr. (Civ.), U.S. Engrs., Edmonton Motors, Edmonton, Alberta, Canada.

LEECH, NORMAN AUSTIN (M. '43), 120 South Louise St., Glendale, Calif.

LEEPER, LYMAN DENNY (Assoc. M. '42), Asst. Engr., U.S. Engr. Dept., 4550 Brazil St., Los Angeles (Res., 8401 Second Ave., Inglewood), Calif.

MCCRACKEN, WINFIELD A. (Assoc. M. '43), Civ. Engr., Frederic R. Harris, Inc., 720 Electric Bldg. (Res., 1347 Arlington), Houston, Tex.

MCELHANNON, WILLIAM ANDREW (Jun. '42), Ensign, U.S.N.R., 101 Sage Hall, Ithaca, N.Y.

MCKAMEY, JACK B. (Assoc. M. '43), Associate Civ. Engr., TVA, Douglas Dam Rural Station, Jefferson City, Tenn.

MENDELL, HERMAN ROBERT (Jun. '43), Engr., North Am. Aviation, Inc. (Res., 222 West Arbor Vitae), Inglewood, Calif.

MICHALOS, JAMES PETER (Assoc. M. '43), With Carnegie-Illinois Steel Corp. (Res., 3550 Washington St.), Gary, Ind.

MIDDLETON, CHARLES CALLOWAY, JR. (Jun. '42), Junior Civ. Engr., TVA, 201 Pound Bldg., Chattanooga, Tenn.

MINTZER, OLIN WESLEY, III (Jun. '42), Capt., Corps of Engrs., U.S. Army, Woodmont Blvd., Nashville, Tenn.

MORGAN, CHARLES LEROY (M. '43), Vice-Pres., Field, Emerson & Morgan, Inc., 20 Flower Bldg., Watertown, N.Y.

NEALE, WILLIAM FREDERICK (Assoc. M. '43), Res. Engr., Modoluk, Inc., Bainbridge (Res., 812 A Wilson Point Rd., Middle River), Md.

ORLICK, MILTON (Jun. '42), 2d Lt., Air Force, U.S. Army, 376 Warwick St., Brooklyn, N.Y.

ORMSBY, EVERETT JOSEPH (Jun. '43), Junior Engr., U.S. Engr. Office, Honolulu, Hawaii.

POOR, ERNEST RAYMOND (Jun. '42), Ensign, U.S.N.R., 410 Memorial Drive, Cambridge, Mass.

PRICE, REGINALD CARRIER (Assoc. M. '43), Hydr. Engr., National Resources Planning Board, North Interior Bldg., Washington, D.C. (Res., 1600 East West Highway, Silver Spring, Md.)

PYBURN, DEWITT LYMAN (M. '43), Director, State Dept. of Public Works, Capitol Bldg., Baton Rouge, La.

ROCKEY, BUELL EDMOND (Jun. '43), 2d Lt., U.S. Army, 2735 Hubbell Blvd., Des Moines, Iowa.

RORABAUGH, MATTHEW IRVIN (Jun. '43), Asst. Hydr. Engr., U.S. Geological Survey, 531 Federal Bldg., Louisville, Ky.

RUMRILL, HENRY CRAWFORD (Assoc. M. '43), Field Engr., Arundel Corp., San Juan, Puerto Rico. (Res., Conestoga Rd., Berwyn, Pa.)

SAXE, NATHANIEL CHARLES (Jun. '43), Res. Engr., McWilliams Dredging Co. and Nick R. Helmers, Inc., Army Post Office 615, Care, Postmaster, New York, N.Y.

SCHINDLER, ARNOLD LEE (Jun. '43), Ensign, U.S.N.R., 36th Naval Constr. Battalion, Care, Fleet Post Office, San Francisco, Calif.

SEPPA, KARL EINAR (Jun. '43), Civ. Engr., Macco Const. Co., Freight and Ferry Sts., Oakland, Calif.

SHORT, HARRY HAMMOND (Jun. '43), Ensign U.S.N., 24 North 1st St., Paris, Tex.

SINGLETARY, EMORY GORDON (Assoc. M. '43), Lt., CEC, U.S.N.R., 105 Homewood Ave., Greensboro, N.C.

SITTS, HAROLD FREDERICK (Jun. '42), 1st Lt., Corps of Engrs., U.S. Army, Route 1, Box 21, Sumner, Wash.

STARBUCK, ROBERT FRANCIS (Assoc. M. '43), Asst. Structural Engr., Eng. Dept., Constrs., Pacific Naval Air Bases, Box 2459, Honolulu, Hawaii.

STEWART, CARL MORRELL, JR. (Jun. '42), Engr., Cont. Div., Dravo Corp., Neville Island, Pittsburgh, Pa. (Res., 337 Glendora Ave., Louisville, Ky.)

TIGRAK, MEHMET FUAT (Jun. '43), 611 West Healey St., Champaign, Ill.

TIMMONS, EDMOND AMPLIAS (Jun. '42), Lt., U.S. Army, 2209 Buchanan St., Amarillo, Tex.

TRUE, CLARENCE HARVEY (Assoc. M. '43), Associate Engr., Office Eng. Div., The Panama Canal, Balboa Heights, Canal Zone.

UYANIK, MEHMET ENSAR (Jun. '43), 211 West Elm St., Urbana, Ill.

VAUGHN, FRANCIS ARTHUR (Assoc. M. '43), 1st. Lt., Engr. Battalion, U.S.M.C., F.M.F.T.C., Camp Pendleton, Oceanside, Calif.

VOGEL, HAROLD RAY (Jun. '42), 2d Lt., U.S.M.C.R., 4432 North 16th St., Arlington, Va.

WALKER, JACK EDWIN (Jun. '42), With Air Force, U.S. Army, 3116 East 9th St., Des Moines, Iowa.

WARFIELD, WILLIAM FITTS (Jun. '43), With Michael Baker, Jr., Box 45, Liberty, Tex.

WESSLEY, STEPHEN EUGENE, JR. (Jun. '43), Engr.-Draftsman, The Central R.R. of N.J., Jersey City, N.J. (Res., 2629 Sedgwick Ave., New York, N.Y.)

WISE, NELSON ELDON (Assoc. M. '43), Associate Engr., Municipal Eng. Div., The Panama Canal, Balboa Heights, Canal Zone.

TOTAL MEMBERSHIP AS OF APRIL 9, 1943	
Members	5,888
Associate Members	7,163
Corporate Members	13,051
Honorary Members	35
Juniors	5,519
Affiliates	71
Fellows	1
Total	18,677
(Total April 9, 1942	17,675)

Membership Transfers

BATES, ABEL JACOB (Jun. '32; Assoc. M. '43), Constr. Engr., Sanders Eng. Co., Navy Yard, Portsmouth, N.H.

BRILL, ROYSE HARLAN (Jun. '40; Assoc. M. '43), Associate Field Engr., The Montana Power Co., Butte, Mont.

CARTER, MARSHALL SYLVESTER (Jun. '36; Assoc. M. '43), Lt. Col., Gen. Staff, U.S. Army, 4744 Reservoir Rd., N.W., Washington, D.C.

DONLEY, DAVID EDWARD (Assoc. M. '36; M. '43), Lt. Col., Ordnance Dept., U.S. Army, 756 Willey St., Morgantown, W.Va.

ERICKSON, ARCHIE MILTON (Jun. '27; Assoc. M. '36; M. '43), Cons. Engr. (Wilcox & Erickson), 11 East 44th St., New York, N.Y.

FOSTER, WILLIAM SOUTHMAYD (Jun. '37; Assoc. M. '43), Eng. Editor, *The Am. City Magazine*, 470 Fourth Ave., New York, N.Y.

FRANKLIN, WILLIAM ROBERT (Jun. '26; Assoc. M. '31; M. '43), Lt. Comdr., CEC, U.S.N.R., 6 East Main Rd., Newport, R.I.

HANRAHAN, FRANCIS JOHN (Jun. '30; Assoc. M. '34; M. '43), Structural Engr., National Lumber Mfrs. Assn., 1319 Eighteenth St., N.W. (Res., 6220 Wagner Lane, Friendship Station), Washington, D.C.

HARKRIDER, CLOVIS JOSEPH (Jun. '38; Assoc. M. '43), Senior Constr. Engr., Federal Public Housing Authority, Electric (Res., 1217 Woodland Ave.), Fort Worth, Tex.

LE MOYNE, CHARLES, JR. (Jun. '33; Assoc. M. '43), Capt., Infantry, U.S. Army, Crescent Rim Drive, Boise, Idaho.

PRICE, WESTCOTT WILKIN, JR. (Jun. '39; Assoc. M. '43), Constr. Mgr., Inter-Mountain Contrs., Box 569, Tooele, Utah.

REGNIER, RAYMOND COBINGTON (Jun. '35; Assoc. M. '43), Capt., Corps of Engrs., U.S. Army, Chemical Warfare Service, Huntsville Arsenal, Huntsville, Ala.

RICH, HENRY MERRITT (Assoc. M. '28; M. '43), Head Engr., U.S. Engr. Office, Wright Bldg. (Res., 1361 Forty-Second St.), Sacramento, Calif.

RIZZI, CHARLES ALFRED (Assoc. M. '41; M. '43), Vice Pres., R. E. Carrick Co., 420 Madison Ave., New York (Res., 13 Wakefield Rd., Scarsdale), N.Y.

ROOT, WALTER HAROLD (Assoc. M. '20; M. '43), Maintenance Engr., State Highway Comm., Highway Comm. Bldg., Ames, Iowa.

STRONG, CHARLES HENDERSON (Jun. '36; Assoc. M. '43), Engr., Strong & Macdonald, Inc., 4045 Ruston Way, Tacoma, Wash.

TARLETON, COLBY DUTOT (Jun. '25; Assoc. M. '31; M. '43), Lt. Comdr., CEC, U.S.N., Navy Housing Office, 100 South Drive, Honolulu, Hawaii.

THORNTON, CHARLES VICTOR (Jun. '35; Assoc. M. '43), Chf. Engr., Southern Iron Works, Inc. (Res., 930 Second St.), Alexandria, Va.

WILCOXEN, LEWIS CLARK (Assoc. M. '28; M. '43), Lt., CEC, U.S.N.R., 833 Chalmers Ave., Detroit, Mich.

WILLIAMS, GORDON LEE (Jun. '36; Assoc. M. '43), Associate Civ. Engr., TVA, Fontana Dam, N.C.

REINSTATEMENTS

CHAPIN, DOUGLAS BRYANT, Assoc. M., reinstated Mar. 26, 1943.

HALL, HOWARD WASHINGTON, Assoc. M., reinstated Mar. 29, 1943.

RAY, OLIVER ADAM, Jun., reinstated Mar. 29, 1943.

RESIGNATIONS

CURTISS, GREY WILLIS, Assoc. M., resigned Mar. 19, 1943.

HUTCHINGS, JOHN BACON, JR., M., resigned Mar. 19, 1943.

KELSALL, FRED ANDERSON, Jun., resigned Mar. 18, 1943.

PARKIN, GEORGE THOMAS, Assoc. M., resigned Mar. 19, 1943.

SIECKE, KURT HUGO, Assoc. M., resigned Mar. 30, 1943.

WEAVER, CHARLES JOSEPH, M., resigned Mar. 15, 1943.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment from Members to Board of Direction

MAY 1, 1943 NUMBER 5

The Constitution provides that the Board of Direcion shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years RCM*
Associate Member	Qualified to direct work	27 years	8 years	1 year RCA*
Junior	Qualified for subprofessional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years	5 years RCM*

* In the following list RCA (responsible charge—Associate Member standard) denotes years of responsible charge of work as principal or subordinate, and RCM (responsible charge—Member standard) denotes years of responsible charge of IMPORTANT work, i.e., work of considerable magnitude or considerable complexity.

APPLYING FOR MEMBER

BLACK, CHARLES WARREN, Baltimore, Md. (Age 45) (Claims RCA 6.2 RCM 16.9) 1919 to date with The Arundel Corporation, as Asst. Plant Engr., Asst. Chf. Engr., Chf. Engr., and (since Feb. 1940) Vice-Pres.

BUTTS, STEPHEN DECATUR, Detroit, Mich. (Age 55) (Claims RCA 9.7 RCM 22.3) 1934 to date Engr., O. W. Burke Co.

CARRICK, ROBERT EDWARD (Assoc. M.), New York City. (Age 58) (Claims RCA 10.0 RCM 28.0) 1920 to date Pres. of R. E. Carrick Co.

CHAMBERLAIN, ANTONIO ARRILLAGA (Assoc. M.), Preston, Cuba. (Age 38) (Claims RCA 5.5 RCM 5.7) Aug. 1937 to date with Frederick Snare Corporation, New York City, as Res. Engr., Field Supt., Asst. Gen. Supt., and (since April 1942) Gen. Supt.

COLLINS, ALFRED STUART, Buffalo, N.Y. (Age 47) (Claims RCA 10.2 RCM 8.8) Jan. 1939 to date Cons. Engr., Buffalo; previously Structural Engr., Frederick C. Backus, Archt.; with Greeley & Hansen, Hydr. & San. Engrs.

DE SALIGNAC, LOUIS LEON, New Orleans, La. (Age 48) (Claims RCA 7.0 RCM 18.0) April 1920 to date with Mexican Petroleum Corporation of Louisiana, Inc. (later successively Pan American Southern Petroleum Corporation and Pan American Petroleum Corporation), in various capacities, at present at Chf. Engr.

DIEHL, OLIVER CHARLES, Pittsburgh, Pa. (Age 40) (Claims RCA 6.1 RCM 6.4) July 1926 to date with American Bridge Co., as Draftsman, Asst. Engr., Field Engr., and (since Dec. 1936) Erecting Engr.

ESTES, CHARLES CRAWLEY, River Forest, Ill. (Age 43) (Claims RCA 4.6 RCM 16.1) July 1929 to date with Forest Preserve Dist., Cook County, Ill., as Chf. Constr. Engr., Asst. Chf. Engr., and (since Jan. 1937) Chf. Engr.

FEILD, JAMES WYATT, Alexandria, Va. (Age 45) (Claims RCA 2.0 RCM 12.7) Oct. 1939 to date Civ. Engr., War Dept., first with Office of Constr. QM., Panama Canal Dept., Canal Zone, and since March 1940 in office of QM. Gen. and of Chf. of Engrs., Washington, D.C.

FREEMAN, CARLYLE BANCROFT, Shaker Heights, Ohio. (Age 57) (Claims RCA 5.0 RCM 28.3) Jan. 1926 to date Pres. and Treas., Freeman & Jones, Inc., Cleveland.

FULTON, EDWARD ARTHUR, St. Louis, Mo. (Age 44) (Claims RCA 6.8 RCM 11.2) Feb. 1932 to date Consultant on work in St. Louis.

GARRELTS, JEWELL MILAN (Assoc. M.), Tenafly, N.J. (Age 39) (Claims RCA 1.0 RCM 6.0) Sept. 1927 to date with Columbia Univ., as Instructor in Eng., Associate in Mechanics, Asst. Prof., and (since June 1939) Associate Prof., of Civ. Eng.; since Jan. 1936 also Designing Engr., Waddell & Hardesty.

HADDEN, SAMUEL CORNELIUS, Indianapolis, Ind. (Age 60) (Claims RCA 15.8 RCM 18.0) Jan. 1941 to date with State Highway Comm. of Indiana, Indianapolis, since Nov. 1941 as chainman; previously Eng. Director (Executive Secy.), Indiana Mineral Aggregate Assn. of Indianapolis.

HALL, LEWIS WATSON (Assoc. M.), Little Rock, Ark. (Age 40) (Claims RCA 11.2 RCM 5.1) Dec. 1941 to date Road and Railroad Engr., Sanderson & Porter, Engrs. & Constrs.; previously Railroad Designer, Holway & Cochrane, Archt. Engrs.; with Arkansas Highway Dept. in various capacities.

HENDERSON, JOHN LOWELL, Vancouver, Wash. (Age 44) (Claims RCA 3.8 RCM 13.2) April 1942 to date Coordinating Supt. of Constr. and Tech. Adviser, Housing Authority of Vancouver, Wash.; previously City Engr., Street Commr., and Water Supt., Vancouver.

HIESTAND, FRANCES HALL, Ridgefield, N.J. (Age 45) (Claims RCA 3.5 RCM 18.9) May 1942 to date Engr. and Project Mgr., S. J. Groves & Sons Co.; previously Design Engr., Holabird & Root, Chicago, Ill.; Consultant on projects in Wisconsin; Div. Engr., Mead, Ward & Hunt, Cons. Engrs., Madison, Wis.; Supervisor of Operations and Dist. Mgr., WPA.

HUMBER, JASON, Houston, Tex. (Age 47) (Claims RCA 12.7 RCM 7.4) June 1922–Jan. 1932 Chf. Engr., and July 1937 to date partner, and (at present) sole owner of firm, Howe & Wise, Civ. Engrs., Houston.

INGS, JASPER HAROLD (Assoc. M.), Niagara Falls, Ont., Canada. (Age 40) (Claims RCA 3.0 RCM 12.2) April 1936 to date Engr., H. G. Acres & Co., Niagara Falls, Ont., acting as Res. Engr., on various projects.

KOERNER, FRITZ A., Brooklyn, N.Y. (Age 37) (Claims RCA 3.1 RCM 11.3) May 1942 to date Senior Engr., Corps of Engineers, War Dept.; previously with FWA, PWA, finally as Chf., Eng. Sec., Manhattan Borough office.

LEWIS, JAMES SPENCER, JR. (Assoc. M.), Dandridge, Tenn. (Age 38) (Claims RCA 5.7 RCM 10.7) Dec. 1933 to date with TVA, as Asst. Design Engr., Supervisor of Foundation

Treatment, Asst. Constr. Supt., and (since Aug. 1940) Constr. Supt.

LUCCHESI, DAVID HOWE, JR., Baltimore, Md. (Age 54) (Claims RCA 11.8 RCM 21.6) Aug. 1940 to date on structural engineering for Koppers Co., Bartlett Hayward Div.; previously Project Supt., National Park Service.

MCCLURE, GEORGE CAVE, Santa Fe, N.Mex. (Age 43) (Claims RCA 2.8 RCM 12.4) at present Lieut., U.S.N.R., CEC; Nov. 1934 to Aug. 1936 Asst. Engr., and Feb. to March 1943 Associate Civ. Engr., U.S. Forest Service; in the interim with SCS and PRA.

MCGOWAN, FRANK MITFORD, Boston, Mass. (Age 53) (Claims RCA 7.8 RCM 21.0) July 1915 to date Chf. Engr. and (since 1921) Vice-Pres., William M. Bailey Co., Contrs. & Bldrs., Boston.

PACKSHAW, SAVILE, London, England. (Age 38) (Claims RCA 3.6 RCM 10.0) Sept. 1929 to date with British Steel Piling Co., Ltd.

PATTERSON, WILLIAM LAWRENCE (Assoc. M.), Kansas City, Mo. (Age 38) (Claims RCA 2.1 RCM 7.7) Aug. 1928 to date with Black & Veatch, as Designer, Superv. Engr., Chf. Designer, and (since April 1942) Chf. Engr.

PORTER, FRED BAKER (Assoc. M.), Ft. Worth, Tex. (Age 61) (Claims RCA 1.0 RCM 36.0) 1912 to date Pres., Ft. Worth Laboratories, and 1916 to date also Pres., Southwestern Laboratories.

RICHHEIMER, CHARLES EDWARD (Assoc. M.), Jacksonville, Fla. (Age 35) (Claims RCA 3.7 RCM 8.5) Jan. 1936 to date Vice-Pres. and member of firm, G. A. Youngberg and Associates, Inc., Cons. Engrs.; since June 1941 also member of firm, Reynolds, Brewton, Smith and Hills (Reynolds, Smith & Hills), Cons. Engrs.

SAMPSON, RAPHAEL (Assoc. M.), Provo, Utah. (Age 37) (Claims RCA 5.6 RCM 5.5) April 1942 to date Office Engr., Utah-Pomeroy-Morrison; previously with California Bridge Dept., Sacramento; with San Francisco–Oakland Bay Bridge.

SAPH, AUGUSTUS VICTOR (Assoc. M.), Berkeley, Calif. (Age 47) (Claims RCA 6.7 RCM 16.0) March 1920 to date in private practice, specializing in structural engineering.

TAGGETT, VERNON NEWTON, Niles, Mich. (Age 56) (Claims RCA 1.5 RCM 29.0) April 1921 to date City Engr., Niles, Mich.

TANDY, MILAM FLACK (Assoc. M.), Louisville, Ky. (Age 38) (Claims RCA 4.1 RCM 7.7) Feb. 1943 to date not formally employed; Sept. 1939 to Feb. 1943 with Firestone Plantations Company, Akron, Ohio, as Chf. Engr., Lower Falls power project on Farmington River, Liberia, West Africa; previously (10 years) Asst. to Chf. Engr. New Kanawha Power Co. (Electro Metallurgical Co.), Glen Ferris, W. Va.

WENTHE, ALBERT WILLIAM, St. Louis, Mo. (Age 42) (Claims RCA 5.1 RCM 12.6) June 1925 to date with Fruin-Colnon Contr. Co., in various capacities, since Dec. 1938 as Treasurer and Director.

WININGER, EDWARD, Irvington-on-Hudson, N.Y. (Age 43) (Claims RCA 1.2 RCM 17.4) July 1934 to date Pres. and member of firm, Wininger & Selby, Inc., Gen. Contrs., New York City.

WOODBURN, CHESTER CHARLES, Des Moines, Iowa. (Age 49) (Claims RCA 2.0 RCM 20.2) 1941 to date on leave of absence from firm, Dougher, Rich & Woodburn, Archts. & Engrs. being Res. Archt. for Smith, Hinchman & Grylls and Howard R. Green, Archts. & Engrs., and (at present) Res. Administrator for Smith Hinchman and Grylls and Jerry Donohue Eng. Co., Archts. & Engrs.

WRIGHT, CHARLES PENZEL (Assoc. M.), Hiwassee Dam, N.C. (Age 38) (Claims RCA 8.0 RCM 5.3) July 1934 to date with TVA in various capacities, since June 1941 as Constr. Engr.

APPLYING FOR ASSOCIATE MEMBER

ALBRECHT, RICHARD WILLIAM (Junior), Brooklyn, N.Y. (Age 27) (Claims RCA 2.0) Feb. 1942 to date Instructor in Civ. Eng., Coll. of City of New York; concurrently and previously Designer, Waddell & Hardesty.

BASTA, RUDOLPH FRANCIS (Junior), Mobile, Ala. (Age 32) (Claims RCA 5.5) Feb. 1943 to date Civ. and Structural Engr., Aluminum Ore Co.; previously Associate Engr. (Civil), U.S. Engrs., War Dept., Mobile; Asst. Structural Engr., Third Locks Project, Diablo Heights, C.Z.; Jun. Engr. and Asst. Engr., TVA, Knoxville, Tenn.

BEARD, FRANK WENDELL, Dallas, Tex. (Age 28) (Claims RCA 5.0) Oct. 1942 to date Engr., Leland Fikes, Contr., Osage Constr. Co. and Stovall Constr. Co. (same management), Dallas; previously Office Engr. and Chf. Engr., Niven, Staub, Rather and Turner, Houston; Asst. Office Engr., Lockwood & Andrews and David M. Duller, Houston; with Koch & Fowler, Dallas.

BOYER, PETER BOYAJIAN, Portland, Ore. (Age 36) (Claims RCA 3.8 RCM 1.1) June 1939 to date with U.S. Army Engrs., as Jun. Engr., Asst. Engr., and (since Dec. 1942) Associate Engr.

BUTTERWICK, WARD RICHARD, Washington, D.C. (Age 27) (Claims RCA 3.9 RCM 1.3) Jan. 1942 to date Street Engr. with Kenneth Franzheim, Archt.; previously Draftsman, Missouri Pacific Lines; Draftsman and Structural Designer with Francis J. Niven, Cons. Engr., Houston, Tex.

CAREY, WILLIAM NELSON, JR., Jacksonville, Fla. (Age 27) (Claims RCA 1.9 RCM 2.0) June 1938 to March 1939 Asst. Eng. Aide and Aug. 1941 to date Capt., and (at present) Major, Corps of Engrs., U.S. Engr. Dept., Jacksonville; in the interim Special Engr. Representative for Carney Co., Mankato, Minn.

COMERFORD, WILLIAM PIERRE (Junior), Bayside, N.Y. (Age 31) (Claims RCA 7.4 RCM 0.9) Nov. 1942 to date Designer, Corry & Zurmuhlen; previously Structural Designer, Madigan-Hyland; Draftsman, Dept. of Parks, New York City; Structural Draftsman, Borough Pres. of Manhattan.

COOPER, SAMUEL CLARENCE, Albuquerque, N. Mex. (Age 36) (Claims RCA 8.0) April–Dec. 1942 Designing Engr., and Jan. 1943 to date Chf. Engr., Haynes & Strange, Parkhill, Volecker & Dixon, Lubbock, Tex.; previously City Engr., Coleman, Tex.

DEMPSEY, JOHN GODDARD, Somerset Bridge, Bermuda. (Age 39) (Claims RCA 5.7 RCM 1.7) Aug. 1941 to date Concrete Engr., F. H. McGraw & Co. and Purdy-Henderson Co., Inc.; previously with U.S. Engr. Office, finally as Prin. Eng. Aide.

GAFFNEY, THOMAS JOSEPH, Baltimore, Md. (Age 50) (Claims RCA 12.8 RCM 8.1) June 1923 to date with Bureau of Highways, Baltimore, Md., as Asst. Civ. Engr., Constr. Engr., and (since April 1935) Associate Engr.

GODFREY, JAMES EMMASON (Junior), Queens Village, N.Y. (Age 32) (Claims RCA 3.2) April 1941 to date Structural Detailer and Designer, Waddell & Hardesty, Cons. Engrs.; previously Eng. Asst., Board of Water Supply Designers for New York; Draftsman, Frederic R. Harris, Inc., Cons. Engrs.

GROSS, ROBERT PHILLIP, South St. Paul, Minn. (Age 27) (Claims RCA 1.1) Feb. 1943 to date Appraisal Engr., Appraisal Service Co., Minneapolis; previously Instrumentman, E. I. Du Pont de Nemours, Rosemount; Draftsman and Designer, Harza Eng. Co., Chicago, Ill.

HANN, GEORGE BENDER KREMER, Oxford, N.Y. (Age 36) (Claims RCA 12.5) June 1929 to date Jun. Engr., Grade 1, New York State Dept. of Public Works, Div. of Highways.

HARDMAN, ROBERT LYON, Balboa, C.Z. (Age 30) (Claims RCA 3.7) Sept. 1939 to date with The Panama Canal, Balboa Heights, C.Z., as Jun. Engr., Asst. Engr., and (since April 1941) Associate Engr.; previously Asst. Res. Engr. Inspector, PWA, Ft. Worth, Tex.

HARRIS, FRANK RICH, Pine Bluff, Ark. (Age 39) (Claims RCA 10.9 RCM 3.3) July 1941 to date Chf. Inspector, first with Whitman, Requardt & Smith, Cons. Engrs., Baltimore, and since Dec. 1941 with Sanderson & Porter, Engrs. & Contrs., New York City; previously Constr. Engr., with Upper Potomac River Comm., Luke, Md., and with Caribbean-Archt.-Engr., New York City; Engr., Solomon & Keis, Troy, N.Y.; Field Engr., International Industrial Management Corporation, New York City; Res. Engr., Pennsylvania Turnpike Comm.

HODGE, JEROME, Temple City, Calif. (Age 41) (Claims RCA 19.1) Feb. 1942 to date Associate Engr. (Civ.), War Dept., U.S. Army Engr. Corps, Los Angeles; previously member of firm, Carson & Hodge; with Paddock Eng. Co.

KAMINER, JAMES HEATH (Junior), Lexington, S.C. (Age 28) (Claims RCA 3.7) June 1941 to Feb. 1942 1st. Lieut., QMC, and Feb. 1942 to date Capt., Corps of Engrs., U.S. Army; previously Office and Mech. Engr., Ford, Bacon & Davis, Texas City, Tex.; with The M.W. Kellogg Co. of New York.

MCCOMBS, GLENN CALVIN, Pittsburgh, Pa. (Age 39) (Claims RCA 10.9 RCM 1.0) Sept. 1930 to date Asst. Prof., Carnegie Inst. of Technology; summers 1935 and 1937 Draftsman, Hunting, David & Dunnells, and American Bridge Co.; summers 1940 and 1941 Engr., Koppers Co., Pittsburgh.

MATTIELLO, JOHN JOSEPH, Brooklyn, N.Y. (Age 35) (Claims RCA 5.5 RCM 7.3) Oct. 1942 to date Major, Corps of Engrs., U.S. Army; previously Senior Engr., U.S. Engr. Office, New York Dist.; Pres. and Gen. Mgr., John J. Mattiello Contr. Corporation, New York City.

MOODY, TED MILLARD (Junior), Dallas, Tex. (Age 32) (Claims RCA 5.7) May 1942 to date 1st Lieut. and Capt., Corps of Engrs., U.S. Army, U.S. Engr. Office, Southwestern Div., Dallas; previously Administrative Asst. to Director of Public Works, Dallas.

MOORE, ALBERT MELVILLE, Framingham, Mass. (Age 32) (Claims RCA 1.3) Oct. 1935 to date with U.S. Geological Survey, as Hydr. Engr., Recorder, Jun. Engr., and (since Jan. 1943) Asst. Engr.

NICHOLAS, WILSON CARY, Portland, Ore. (Age 56) (Claims RCA 11.0) Nov. 1910 to Nov. 1914 and July 1918 to date with City of Portland, as Instrumentman, Structural Draftsman, Asst. Bridge Engr., and (since Dec. 1938) Senior Engr.

PARRISH, DUDLEY TUCKER, Takoma Park, Md. (Age 32) (Claims RCA 1.5 RCM 9.8) 1942 to date Chf. Engr. and Asst. Gen. Supt., J. A. Jones Constr. Co., Gulfport, Miss.; Artley Co., Tallahassee, Fla.; TVA; T. A. Loving & Co., Ft. Bragg, N.C.; H. N. Francis & Co., Richmond, Va., etc.

RESCH, WILLIAM FRANK, El Paso, Tex. (Age 42) (Claims RCA 8.9 RCM 7.0) June 1927 to date with U.S. Bureau of Reclamation, as Hydrographer, Project Hydrographer, and (since April 1937) Associate Hydr. Engr.

RICHARDS, ROBERT BENJAMIN, Elmwood Park, Ill. (Age 29) (Claims RCA 2.5 RCM 1.2) July 1936 to date with Charles DeLeuw & Co. and their successors (DeLeuw, Cather & Co.), Chicago, as Draftsman, Asst. Engr., Design Engr., Staff Engr. and (since March 1942) Office Engr.

RUCKER, WALTER WESLEY, Cleburne, Tex. (Age 40) (Claims RCA 11.0) Aug. 1932 to date with Texas Highway Dept., as Concrete Paving and Concrete Piling Inspector, Waco, Tex., and (since Sept. 1933) Instrumentman, Field Engr., and Jun. Res. Engr., Ft. Worth, Tex.

SACKETT, GUY WOODFORD, JR. (Junior), Madison, Wis. (Age 28) (Claims RCA 4.2) Dec. 1941 to Dec. 1942 Lieut. (jg), CEC, U.S.N.R., at present recuperating from spinal injury; previously with Mason & Hanger Co., Inc., New York City, in various capacities.

SAUM, JACK URBAN, Cristobal, C.Z. (Age 33) (Claims RCA 8.2) July 1932 to date civilian employee, Public Works Dept., U.S. Naval Air Station, Coco Solo, C.Z., at present being Prin. Asst. to naval civil engineer.

TYRRELL, GEORGE GILMAN, Baltimore, Md. (Age 52) (Claims RCA 19.6 RCM 5.9) 1942 to date Engr., Madison Eng. Co.; previously Estimator, Cummins Constr. Corporation, Edgewood Arsenal, Md.; Inspector, Montebello Water Tunnel, Baltimore.

WEBB, WILLIAM BRENARD, Denison, Tex. (Age 40) (Claims RCA 5.2 RCM 9.9) March 1942 to date Associate Engr., U.S. War Dept., Corps of Engrs., Mil. Projects Div.; previously Minnesota Branch Mgr., Gen. Filter Co., Ames, Iowa.

WEISS, FREDERICK LOUIS (Junior), Sacramento, Calif. (Age 28) (Claims RCA 2.6 RCM 2.7) March 1942 to date Office Engr., Operations Div., U.S. Engr. Dept., Sacramento Dist. Office; previously Civ. Engr. with W. L. Huber, Cons. Engr., San Francisco.

ZWALLY, CHARLES WILLIAM, Lancaster, Pa. (Age 37) (Claims RCA 14.0) Sept. 1942 to date Dept. Engr., Gannett, Eastman & Fleming, Inc.; previously Highway and Airfield Designer, Caribbean Archt.-Engr.; with Pennsylvania Turnpike Comm.

APPLYING FOR AFFILIATE

MCMILLIN, FREDERICK WILLIAM, JR., Buffalo, N.Y. (Age 42) (Claims RCM 11.6) 1926 to 1930 Sales Engr., and 1934 to date Service Engr. in charge of Dept., Federal Portland (formerly Bessemer) Cement Co., Inc., Buffalo.

APPLYING FOR JUNIOR

DABNEY, JAMES LAWRENCE, Vanport City, Ore. (Age 28) (Claims RCA 1.0) Jan. 1943 to date Engr. Aide, Office of Office Engr., Kaiser Co., Inc., Portland, Ore.; previously Engr. Aide (Computer), Principal, U.S. Engr. Office, Portland, Ore.

ERICSON, EVERT ERIC, Corpus Christi, Tex. (Age 27) Feb. 1943 to date Civ. Engr., Myers & Noyes, Cons. Civ. Engrs., Dallas and Corpus Christi; previously with Magnolia Petroleum Co., as Chainman, Instrumentman, and Civ. Engr.

FLEMING, JULIAN ROANE, Knoxville, Tenn. (Age 31) 1935 to 1940 Instructor, and 1940 to date Asst. Prof., hydraulics and sanitary engineering, Univ. of Tennessee; since 1941 also Jun. Office Engr., TVA.

FLYNN, FRANCIS JOSEPH, Allston, Mass. (Age 29) (Claims RCA 3.1) Oct. 1938 to Sept. 1941 Jun. Engr., and Sept. 1941 to date Asst. Engr., Water Resources Branch, U.S. Geological Survey.

MAXSON, ROBERT ORVILLE, Portland, Ore. (Age 26) (Claims RCA 0.8) Oct. 1941 to date with U.S. Army, as Lieut. and (since Aug. 1942) Capt.; previously with U.S. Geological Survey.

NOBLE, ROBERT JOSEPH, Honolulu, Hawaii. (Age 29) (Claims RCA 1.2) May 1941 to date with U.S. Engr. Office, as Jun. Engr. (Civ.), and (since Aug. 1942) Asst. Engr. (Civ.); previously with South Dakota Highway Dept., Pierre, S.Dak.

PALMER, JESS CLOWER, Fountain City, Tenn. (Age 28) Nov. 1941 to date with TVA, as Eng. Aide, Jun. Engr., and (at present) Jun. Structural Engr. (senior grade); previously with Florida Road Dept.

SHIEFLO, JELMER BURTON, St. Paul, Minn. (Age 32) April 1939 to date with U.S. Dept. of Interior, Geological Survey, first as Rodman, Topographic Branch, then with Water Resources Branch in various capacities, since Sept. 1942 as Asst. Hydr. Engr.

SLOANE, RICHARD LEWIS, Salt Lake City, Utah. (Age 25) (Claims RCA 0.7) Sept. 1942 to date Asst. Prof. of Civ. Eng., Univ. of Utah; previously Asst. Progress Engr., Corps of Engrs., U.S. War Dept.; Instructor, Purdue Univ.

TAYLOR, EUGENE LAMAR, Washington, D.C. (Age 28) (Claims RC 1.8 D 1.8) Feb. 1937 to date with District of Columbia Sewer Dept. as Eng. Draftsman, Jun. Engr., and (since May 1941) Asst. Engr.

WAGNER, GEORGE NICHOLAS, Yukon Territory, Canada. (Age 32) (Claims RC 5.4 D 1.0) Nov. 1933 to April 1935 Leadman, and Oct. 1937 to Feb. 1933 County Road Supt., Dept. of Highways, County of Santa Cruz; in the interim with Granite Constr., Co., Watsonville, Calif.

YORKE, ROBERT BRUCE, JR., Philadelphia, Pa. (Age 28) (Claims RCA 1.5) Feb. 1941 to date Field Engr., Dry Dock Associates (Spencer, White & Prentis, Inc., Foley Bros., Inc., Merritt, Chapman & Scott Corporation), also in office as Eng. Draftsman; previously Eng. Draftsman, Office of Valuation Engrs., Pennsylvania R.R. Co.

1942 GRADUATES

N.Y. UNIV. (B.C.E.)

	AGE
YIP, YEE MOY	(23)

UNIV. OF PA. (B.S. in C.E.)

WINSCH, CHARLES EMIL	(23)

1943 GRADUATES

UNIV. OF AKRON (B.C.E.)

PASTORIUS, HARRY HARTLINE	(23)

BROOKLYN POL. INST. (B.C.E.)

LIPITZ, ELLIOTT ALAN	(20)

BUCKNELL UNIV. (B.S. in C.E.)

REHKAMP, GEORGE JOHN	(21)

UNIV. OF CALIF. (B.S. in C.E.)

KLYCE, HARVEY LOVELL	(22)

COLUMBIA UNIV. (B.S. in C.E.)

PIETRANTONI, MANUEL ANTONIO	(21)

UNIV. OF ILL. (B.S. in A.E.)

GRAVES, WILLIAM EDWARD	(22)

(B.S. in Gen. Eng.)

MEYER, CHARLES ARNOLD	(25)

JOHNS HOPKINS UNIV. (B.E.)

HEGERFELD, HENRY BISHOP	(24)

UNIV. OF LOUISVILLE (B.C.E.)

HEER, JOHN EDWARD, JR.	(21)
WAGNER, CARL, JR.	(22)
WEBER, ERIC THOMAS	(21)

MICH. STATE COLL. (B.S.)

FROST, HENRY LEWIS	(23)

UNIV. OF MINN. (B.C.E.)

BENERT, ROBERT	(23)
LINDSEY, RAY WARREN	(21)
SALL, HARRY HERMAN, JR.	(24)
SCHNARR, RICHARD ALFRED	(23)

UNIV. OF MO. (B.S. in C.E.)

BARTON, ROBERT MCCLURE	(21)
FEHRMAN, ROLLIE GREGG	(27)
HEILMAN, LUTHER JAMES	(26)
MCBEE, OWEN BERNARD	(23)
NEW, JOHN CALHOUN	(22)

NEWARK COLL. OF ENG.

BENSON, WILLIAM CHARLES, JR.	(21)
BLUMENSCHINE, ARTHUR EDWARD, JR.	(22)
CARUSO, VITO	(21)
EARL, LAWRENCE WILLIAM	(20)
FIMMEL, GUSTAV ADOLF	(20)
HACKENBROCH, JOHN PETER	(22)
LYNCH, WILLIAM OSCAR	(20)
NERO, MICHAEL MURRY	(22)
OBERLEITNER, PAUL	(21)
PARRY, KENNETH JAMES	(21)
PETRO, STEPHEN, JR.	(21)
RINDERER, RUDOLPH FREDRICK	(22)
SCHOTT, HENRY KARL	(23)
SURA, WALTER MICHAEL	(20)

COLL. OF CITY OF N.Y. (B.C.E.)

GOLDSTEIN, LOUIS GEORGE	(21)
KAPOR, JESSE	(21)
LOUREKAS, CHRIST	(23)
NOVICK, SIDNEY	(20)
RUBIN, HERMAN	(22)
RYER, WILLIAM THOMAS	(20)
SCHUSTER, IRVING	(22)
SHEIKOWITZ, ISIDORE	(20)
SILBERMAN, MURRAY	(21)
ZIMNOCH, VINCENT PAUL	(22)

N.DAK. AGRI. COLL. (B.S.)

BERGE, PAUL SUNDBY	(22)
GABE, DONALD DUANE	(21)
SCHNUR, RUSSELL LAMONT	(22)

S.DAK. STATE SCHOOL OF MINES (B.S. in C.E.)

HOFFMAN, VINCENT PAUL	(26)

UNIV. OF TENN. (B.S. in C.E.)

GOODRICH, HENRY CALVIN	(23)

UNIV. OF UTAH (B.S. in C.E.)

BROWN, WALLACE MELVIN	(21)
FOWLER, KEITH TRACY	(20)
JONES, CALVIN M.	(21)

UNIV. OF WASH. (B.S. in C.E.)

GEORG, LLOYD	(23)
HENRY, CHARLES JEFFERSON, JR.	(23)
ISBELL, HENRY BURTRUM	(22)
WARBINGTON, ALBERT LEE	(22)

The Board of Direction will consider the applications in this list not less than thirty days after the date of issue.

Engineering Societies Personnel Service, Inc.

NEW YORK	CHICAGO	DETROIT	SAN FRANCISCO	BOSTON
8 W. 40 ST.	211 W. WACKER DR.	100 FARNSWORTH AVE.	57 POST ST.	4 PARK STREET

The items listed below have been furnished by the Engineering Societies Personnel Service, Inc., which is under the joint management of the Four Founder Societies. This service is available to members and is operated on a cooperative, non-profit basis. In applying for positions advertised by the Service the applicant agrees, if actually placed in a position through the Service as a result of these advertisements, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient, non-profit personnel service and are available upon request. This also applies to registrants whose notices are placed in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office.

A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription of $3 per quarter or $10 per annum, payable in advance.

MEN AVAILABLE

CIVIL ENGINEER; 24; Student Chapter member; will receive M.S. in C.E. from leading Eastern university in May 1943; at present working on two-year theoretical and experimental A.I.S.C. research program; 6 months' experience as draftsman; knowledge of German, French, Russian; desires position as stress analyst or structural designer or instructorship in mechanics or structural analysis. C-972.

STRUCTURAL ENGINEER; Assoc. M. Am. Soc. C.E.; 8 years' experience on design and details of steam and hydro power plants, steel mills, aluminum mills, foundry, heavy rigid-frame industrial buildings; two years in field, working as contractor's engineer and surveyor and on hydro plant. Desires field work for heavy construction contractor. Salary, $4,500 per year. C-973.

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; citizen; married; 40; desires executive job, either engineering or administrative. Graduate C.E., Rensselaer Polytechnic Institute; 15 years' general experience in construction and design, some administration. Can organize project, plan it, and direct its execution. Last salary, $6,000. Experience includes airports, highways, structures, concrete, steel, timber, drainage, etc., specifications, contracts. C-974.

SANITARY ENGINEER; M. Am. Soc. C.E.; graduate of Massachusetts Institute of Technology; 21 years' broad administrative, engineering, and sales experience on sewage, water, industrial wastes, and stream pollution. All treatment processes and equipment. In charge of investigations, development, design, construction, and operation. C-975.

CONSTRUCTION ENGINEER; M. Am. Soc. C.E.; now employed on large ordnance-plant construction, will shortly complete assignment. Present assignment is engineer in charge of permanent administration unit consisting of twelve buildings. Record of 23 years of continuous engineering and construction experience. Available now. C-976.

EXECUTIVE ENGINEER; M. Am. Soc. C.E.; 58; available May 1st as construction manager or project engineer on heavy-type construction job. Speaks Spanish. Minimum salary $10,000 per annum. C-977.

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; 43; C.E. degree; over 20 years' experience in electric, gas, and water utilities; engineering, management, accounting. Considerable experience in rates, valuation, and original cost work. Desires executive position where utility and past experience will prove valuable. Location, preferably near New York City. C-978.

CONSTRUCTION MANAGER OR SUPERINTENDENT; M. Am. Soc. C.E.; 54; B.S.C.E., Massachusetts Institute of Technology; married; native American; 32 years' broad construction experience on industrial work, hydro and steam-power stations.

dams, pumping and filtration plants, appraisals, surveys, reports. Location, immaterial. C-979.

ENGINEER-EXECUTIVE; M. Am. Soc. C.E.; 25 years' experience in building construction. Expert on building costs and materials. Familiar with government procedures. Will join organization seeking ability and good judgment. C-980.

POSITIONS AVAILABLE

COMMISSIONS. Civil Engineers for officer candidates in the U.S. Army. Must be 35 to 45 years of age and have had at least 5 years' experience supervising the construction of highways, airports, or dirt removal—that is, drainage, leveling, etc. Apply by letter. Location, anywhere. W-1199.

ASSISTANT PROFESSOR, preferably with teaching experience, to teach hydraulics and sanitary engineering courses. Salary, $2,400 a year. Location, South. W-1245.

ENGINEERS. (*a*) Assistant Construction Superintendent familiar with reinforced concrete construction, masonry, and carpentry. Salary, $3,400–$3,900 a year. (*b*) Field Engineer familiar with reinforced concrete construction masonry and carpentry layout work. Both should have industrial building experience. Salary, $2,340–$2,860 a year. Location, New York, N.Y. W-1504.

COMMISSIONS in the U.S. Army; civil, chemical, or sanitary engineers, 18–45, with a minimum of 4 years' experience in sanitary engineering or public health—either mosquito control, sewerage, or water supply. Must be resident of New York, New Jersey, or Delaware. Headquarters, New York, N.Y. W-1653.

INSTRUCTOR OR ASSISTANT PROFESSOR IN CIVIL ENGINEERING, preferably qualified to teach work in the sanitary field, surveying, and one or two courses in structures. Salary, $1,800 for an instructor, or $2,500 a year for an assistant professor. Location, New England. W-1744.

DRAFTSMAN for plant layouts and simple frame-building design work. Salary, $1,800–$3,200 a year for a 40-hour week plus time and a half for over time up to a 48-hour week. Location, Louisiana. W-1891.

ASSOCIATE OR ASSISTANT PROFESSOR OF STRUCTURAL ENGINEERING. Apply by letter giving complete statement of training, experience, and personal data, and include photograph. Salary, $2,900–$3,600 for 9 months', work with prospect of summer employment at extra compensation. Location, South. W-1921.

CONCRETE SHIP DESIGNERS. Must have had some experience in this type of work. Salary open. Location, New York, N.Y. W-1964.

INSTRUCTOR IN CIVIL ENGINEERING who is qualified to teach junior and senior civil engineering subjects. University now 100% on the Army specialized war training programs. Salary, $2,200–$2,400 for calendar year. Location, New England. W-1973.

DEVELOPMENT ENGINEER, graduate civil, preferably 38–45, who has a good mathematical background and who has had considerable experience on structural design, including both steel and concrete. Must be capable of attacking new problems in structural materials development. Permanent. Location, New York, N.Y. W-1978.

DESIGNERS, either civil or mechanical, 35–55. Will be required to take special training course for industrial design positions. For duration only. Salary during training, about $63 a week; slight increase after training period. Location, New York, N.Y. W-2023.

ESTIMATOR; preferably man who has had a varied experience in the construction field. Must be able to take off all materials and have a knowledge of construction costs. Salary open. Location, New York, N.Y., or Washington, D.C. W-2069.

DRAFTSMEN, experienced, for post-war work in connection with sewage disposal installations. Salary open. Prefer residents of Nassau County. Location, Nassau County, New York. W-2082.

ESTIMATOR who has had considerable experience in taking off quantities from steel plans. Must have had some experience in work for a steel construction company. Company wants thoroughly qualified person. Salary open. Location, New York, N.Y. W-2083.

INSTRUCTORS, in civil, mechanical, and electrical engineering. Should have had wide experience, preferably teaching some of the following subjects: Drawing, descriptive geometry, materials, analytic mechanics and strength of materials, hydraulics or fluid mechanics, thermodynamics and heat power, including laboratory. Location, Pennsylvania. W-2103.

INSTRUCTOR for civil engineering department to teach general civil engineering subjects as well as applied mechanics. Salary, $2,400 for ten months, plus extra compensation for the two extra months. Location, Connecticut. W-2124.

DRAFTSMEN, to 60, either architectural, mechanical, or civil engineers for shipbuilding. Will be taught ship work. Location, Florida. W-2128.

TECHNICAL WRITER. Should be a graduate civil, mechanical, or architectural engineer who has had a thorough knowledge of construction materials. Permanent. Salary, $4,200 a year. Location, New York, N.Y. W-2134.

RECENT BOOKS

New books of interest to Civil Engineers donated by the publishers and filed in the Engineering Societies Library, or in the Society's Reading Room, will be found listed here. The notes regarding the books are taken from the books themselves and are edited by members of the staff of the Society or of the Library. Those books which are in the Library may be borrowed by mail by Society members for a small handling charge.

ANALYTIC GEOMETRY. By E. S. Smith, M. Salkover, and H. K. Justice. John Wiley & Sons, New York; Chapman & Hall, London, 1943. 298 pp., diagrs., tables, 9½ × 6 in., cloth, $2.50.

A college text which aims to adjust the student to the new type of reasoning that analytic geometry calls for, by providing accurate, fully illustrated explanations of the topics commonly taught in that subject.

DIFFERENTIAL EQUATIONS. By H. W. Reddick. John Wiley & Sons, New York; Chapman & Hall, London, 1943. 245 pp., diagrs., tables, 9 × 5½ in., cloth, $2.50.

A textbook dealing with methods of solving ordinary differential equations and with problems in applied mathematics involving such equations. Partial differential equations are not treated. The book is intended for both engineering and liberal arts schools.

ECCENTRIC LOADS ON CONCRETE. By L. T. Evans. Edwards Brothers, Inc., Ann Arbor (Mich.), 1943. 35 pp., plus 46 pp. of charts, diagrs., figs., 11 × 8½ in., cloth.

The primary purpose of this text is to give the profession various methods of solution for both special cases and the general case. Irregular or odd-shaped cross sections with any amount of steel with any distribution are solved with ease by the new "Solution by Parts" method. The second purpose is to explain the "Solution by Parts" method.

EMPIRICAL EQUATIONS AND NOMOGRAPHY. By D. S. Davis. McGraw-Hill Book Co., New York and London, 1943, 200 pp., diagrs., charts, tables, 9½ × 6 in., cloth, $2.50.

The first part of this book describes practical methods for correlating engineering data and deriving usable empircal formulas. The fundamental methods of rectification are explained, together with new techniques for two-variable data, and a method of correlation for equations with three variables. Part two gives an excellent account of the theory and construction of nomographic and line coordinate charts. A good bibliography is included.

INTRODUCTION TO REINFORCED CONCRETE DESIGN, 2 ed. By H. Sutherland, R. C. Reese, and I. Lyse. Based on the first edition by H. Sutherland and the late W. W. Clifford. John Wiley & Sons, New York; Chapman & Hall, London, 1943. 559 pp., diagrs., charts, tables, 9½ × 6 in., cloth, $5.

In this textbook the fundamentals of the subject are presented as simply and completely as possible, with emphasis upon practical considerations. The new edition has been thoroughly revised in the light of new knowledge acquired during the last sixteen years.

MAPS AND SURVEY, 4 ed. By A. R. Hinks. Macmillan Co., New York; University Press, Cambridge, England, 1942. 301 pp., illus., diagrs., charts, maps, tables, 9 × 5½ in., cloth, $3.75.

This is intended as an introduction to the study of maps and the processes of survey by which they are made. Starting with a brief history of ancient maps, the author describes the modern map and the methods used in producing it. Chapters are then devoted to the maps published in various countries. The second part of the book describes the various methods of surveying and its different applications, with some account of the instruments used.

MECHANICAL VIBRATIONS. By R. K. Bernhard. Pitman Publishing Corporation, 1943. 139 pp., illus, diagrs., charts, 9 × 6 in., cloth, $3.

This book makes possible the recognition of safer and more economical methods of design and construction by civil, mechanical, and automotive engineers and students. Part I treats physical phenomena and their significance in engineering dynamics. Part II takes up measuring technique, typical dynamic measuring instruments, and dynamic testing methods. Each of the two parts may be used as a separate unit.

MECHANICS OF MATERIALS, 2 ed. By S. G. George and E. W. Rettger; revised by E. V. Howell. McGraw-Hill Book Co., New York and London, 1943. 491 pp., diagrs., charts, tables, 9½ × 6 in., cloth, $3.75.

A simple, complete account of the essentials of the subject is provided, suitable for use as a college text, but containing more material than is usually covered in an elementary course. In this edition the sequence of chapters has been altered, rivet and column specifications have been revised, and an article added on the graphical solution of combined stresses.

NATIONAL CONFERENCE ON PLANNING, Proceedings of the Conference Held at Indianapolis, Indiana, May 25–27, 1942. American Society of Planning Officials, 1313 East 60th St., Chicago, Ill., 1942. 228 pp., diagrs., charts, tables, 9½ × 6 in., cloth, $2.50.

This book consists of addresses and discussions delivered at the Conference. Post-war planning, the problem of converting war industries to peace uses, the manpower crisis, war housing and city rebuilding after victory, state and municipal planning, are discussed by experienced men.

STRATIGRAPHY OF THE EASTERN AND CENTRAL UNITED STATES. By C. Schuchert. John Wiley & Sons, New York, 1943. 1013 pp., illus., diagrs., charts, maps, tables, 9 × 6 in., cloth, $15.

The late Dr. Schuchert's monumental work on the historical geology of North America presents data upon which are based a series of maps depicting the ancient geographies, and throws light upon the causes that change the relative levels of land and sea. In this, the second volume of the work, the author discusses the stratigraphy of thirty eastern and central states, including Texas. An enormous mass of data is organized systematically, with references to sources, forming a reference work of permanent usefulness.

STRUCTURAL GEOLOGY. By M. P. Billings. Prentice-Hall, New York, 1942. 473 pp., illus., diagrs., charts, maps, tables, 9½ × 6 in., cloth, $4.50.

This is an elementary textbook, confined to the study of relatively local structural units, in which the emphasis is on principles, methods, and technique. The structure of specific local areas is not discussed, except to illustrate principles. Laboratory exercises and problems are provided.

TABLE OF ARC TAN X, prepared by the Federal Works Agency, Work Projects Administration, for the City of New York, as a Report of Official Project No. 165–2–97–22, Mathematical Tables Project. A. N. Lowan, Technical Director; conducted under the sponsorship and for sale by the National Bureau of Standards, Washington (D.C.), 1942. 169 pp. tables, 11 × 8 in., cloth, $2.

This table of the inverse tangent is claimed to be the most comprehensive yet published. The angle is given in radians, and the function is calculated to twelve decimals, calculated over the range of x from 0 to 10,000.

(THE) TENNESSEE VALLEY AUTHORITY. By J. S. Ransmeier. Vanderbilt University Press, Nashville (Tenn.), 1942. 486 pp., diagrs., charts, tables, 9 × 5½ in., cloth, $3.

The aim of this study is to contribute to clarification of the problem of cost allocation when river control is undertaken for multiple purposes. The author studies the problem as presented by the Tennessee Valley Authority. The development of the program is presented, the various theories and problems of cost allocation are discussed critically, and the planning and policy examined.

TIME STUDY FOR COST CONTROL, 2 ed. By P. Carroll, Jr., foreword by C. D. Dyer, Jr. McGraw-Hill Book Co., New York and London, 1943. 301 pp., illus., diagrs., charts, tables, 9½ × 6 in., cloth, $3.

This book is intended for industrial engineers and executives interested in installing or improving a system of time study. It explains the application and advantages of time study based on predetermined standards, describes the establishment of a standards department, and outlines step by step a practical method of completing the time-study measurement and control of cost without rearranging the shop.

WEATHER SCIENCE (AN ILLUSTRATED OUTLINE OF). By C. W. Barber. Pitman Publishing Corp., New York and Chicago, 1943. 248 pp., illus., diagrs., charts, tables, maps, 9½ × 6 in., cloth, $2.50.

This concise textbook presents the course in meteorology, developed at the U.S. Naval Air Station at Lakehurst for training Naval Air Cadets. The subject is clearly presented, with profuse use of visual aids and with many questions.

CURRENT PERIODICAL LITERATURE

Abstracts of Articles on Civil Engineering Subjects from Publications (Except Those of the American Society of Civil Engineers) in this Country and Foreign Lands

Selected items for the current Civil Engineering Group of the Engineering Index Service, 29 West 39th Street, New York, N.Y. Every article indexed is on file in The Engineering Societies Library, one of the leading technical libraries of the world. Some 2,000 technical publications from 40 countries in 20 languages are received by the Library and are read, abstracted, and indexed by trained engineers. With the information given in the items which follow, you may obtain the articles from your own file, from your local library, direct from the publisher, or they may be borrowed from The Engineering Societies Library. Photoprints will be supplied by this library at the cost of reproduction, 25 cents per page to members of the Founder Societies (30 cents to all others), plus postage, or technical translations of the complete text may be obtained at cost.

BRIDGES

CONCRETE ARCH, WASHINGTON. Design and Construction of Concrete Multiple Arch Bridge over Spillway of Grand Coulee Dam, E. R. Dexter. *Am. Concrete Inst.—J.*, vol. 14, no. 3, Jan. 1943, pp. 149–163. Bridge has over-all length of 1,650 ft and consists of 11 units supported by piers 15 ft thick in direction of traffic and spaced at 150-ft centers; each unit consists of roadway section supported by vertical cross walls resting on barrel-type parabolic arch; construction operations; design control; camber; design loadings; piers; design of arch barrel; superstructure; deflections.

CONCRETE, STRESSES. Safe Loads for Existing Concrete Bridges, F. W. Panhorst. *Am. Concrete Inst.—J.*, vol. 14, no. 3, Jan. 1943, pp. 185–192. Committee 320 was organized to formulate procedure for determining safe loads on existing concrete highway bridges; paper discusses committee's understanding of assignment and offers tentative procedure.

IRON AND STEEL SCRAP. Steel Scrap from Old Highway Bridges Salvaged to Build New Structures, W. A. Douglass. *Calif. Highways & Pub. Works*, vol. 21, no. 1, Jan. 1943, pp. 13–14. Use of salvaged steel in repair and construction of bridges; examples cited; timber bridges replaced; widening of Washington Underpass at western entrance to Sacramento may be made possible by use of salvaged girders from abandoned railroad bridge near Port Chicago.

RAILROAD. Renewing Light Spans Strengthens Line for Wartime Traffic, A. R. Harris. *Ry. Age*, vol. 114, no. 7, Feb. 13, 1943, pp. 350–352 and 358. Author explains how Chicago & North Western Railroad completed renewal of bridge over Mississippi River at Winona, Minn., on heavy traffic line without interfering with trains.

RAILROAD CONSTRUCTION. Retirement of Old Viaduct Speeds Traffic on Two Railroads. *Ry. Age*, vol. 114, no. 6, Feb. 6, 1943, pp. 316–318 and 322. Article explains how bottleneck in movement of wartime traffic over Nickel Plate and Pennsylvania railroads was removed and replaced by earth embankment supported by double concrete arch.

STEEL, PRESTRESSING. Prestressing New Girders of Palar Bridge, 13 Spans of 150 Ft Each, Villupuram-Katpadi Branch, S. I. Railway, R. Madhavachari. *Instn. Engrs. India—J.*, vol. 22, no. 2, June 1942, pp. 149–173. Details of method of design and erection by prestressing girders applied to Palar Bridge in 1938 to meet present-day needs of traffic; calculations made for prestressing; temporary diversion of railway line; supporting girder spans during erection; tools and plant.

SUSPENSION, PIPE LINES. Company Saves Much Pipe by Building Suspension Bridge, G. M. Wilson. *Oil Weekly*, vol. 108, no. 11, Feb. 15, 1943, pp. 11–13. Description of installation of 1,100-ft suspension cable across ravine, in mountainous oil field in locality not specified; major producing company saved about 9 miles of line pipe in sizes from 2 to 4 in., for oil, wet-gas, water, and dry-gas lines serving part of field; construction methods.

WOODEN, STANDARDS. Report of Committee 7—Wood Bridges and Trestles. *Am. Ry. Eng. Assn.—Bul.*, vol. 44, no. 436, Jan. 1943, pp. 361–378, 1 supp. sheet. Specifications for design of wood bridges and trestles; bearing power of wood piles, with recommendations as to methods of determination; recommended relationships between energy hammer and weight or mass of pile for proper pile driving, to include concrete piles.

BUILDINGS

CAMPS, MILITARY. Navy Camp Built from Non-Critical Materials. *Eng. News-Rec.*, vol. 130, no. 4, Jan. 28, 1943, pp. 124–127. Substituting asbestos cement sheets of 1/8-in. thickness for 3/8-in. thick plywood originally specified for exterior sheathing, contractors for Navy's Camp Bainbridge, Md., were able to eliminate more critical wood; thin asbestos sheets over plaster board and tar paper provide attractive, fireproof wall; glued, laminated arches form ribs for drill hall of 120-ft span.

DESIGN. Progress in Structural Elements of Buildings, T. L. Condron. *Western Soc. Engrs.—J.*, vol. 47, no. 5, Oct. 1942, pp. 208–238. Historical review of structural materials and design; wood in building construction; earliest cast-iron beams and girders; plate, box, and rolled beams, columns and wide-flanged beams; welding and riveting; foundations and foundation materials; reinforced concrete construction.

HOUSING, UNITED STATES. Municipal Improvements for Large War Housing Projects in Norfolk and Portsmouth, Virginia, H. W. Alexander. *Pub. Works*, vol. 74, no. 2, Feb. 1943, pp. 20–26, 28, 30, and 32. Discussion of engineering problems encountered in designing and constructing municipal improvements for 8,400-dwelling-unit project.

WRECKING. Demolishing Blitzed Buildings. *Am. City*, vol. 58, no. 2, Feb. 1943, pp. 45–46. Article explains how Britain's Royal Engineers raze dangerously damaged buildings.

CITY AND REGIONAL PLANNING

ARGENTINA. Urbanismo, I. V. Schuster. Published privately in Buenos Aires, 1941, 184 pp. New system of town planning is presented; hygiene; military defense; land values; laying out of cities; buildings; roads; vehicles; utilities; esthetics.

PLANNING LAWS AND PRACTICES. Planning, W. S. Cameron. *Surveyor*, vol. 101, no. 2,654, Dec. 4, 1942, pp. 415–416. Review of presidential address before Town Planning Inst.; training of planners; municipal engineers and planning; road development; laws of highway design; bridge design.

POST-WAR. They Plan New London, L. A. G. Strong. *Am. City*, vol. 58, no. 2, Feb. 1943, pp. 49–50. Note on post-war city planning; when and how to rebuild; five main objects. From *Britain*, Jan. 1943.

CONCRETE

AIRPORT RUNWAYS. Paving with Concrete in Freezing Weather, G. Pulley. *Pacific Bldr. & Engr.*, vol. 49, no. 2, Feb. 1943, pp. 30–37. Details of procedure followed by Army engineers and contractors in paving major airport in Pacific Northwest with Portland cement concrete; precautions taken because of near-zero temperatures.

CONSTRUCTION. Job Problems and Practice. *Am. Concrete Inst.—J.*, vol. 14, no. 3, Jan. 1943, pp. 213–219. Notes on following: "Charming Old Port Town" in Southwestern Pacific, C. C. Everhart; Method of Mix Control for Light-Weight Aggregates, H. G. Collins; Concrete in Water-Containing Structures, F. L. Fitzpatrick; Variations in Weight of Mortar Pots Due to Humidity, R. F. Adams; Concrete for Railway Bridge Decks, with Rails Directly Attached.

CONSTRUCTION. New Method of Applying Concrete—Saves Time and Material, H. F. Simons. *Oil & Gas J.*, vol. 41, no. 37, Jan. 21, 1943, pp. 34–35. Walls of salt-water-disposal pits in East Texas field are being lined by spraying of cement; procedure described is expected to find increasing use in oil industry construction, as its time- and cost-saving benefits become more generally known.

CULVERTS. Culverts with Concrete-Block Walls, M. H. Woodward. *Better Roads*, vol. 13, no. 2, Feb. 1943, pp. 19–20. Wartime structures developed in Greenville County, S.C., built readily with convict labor; scrap steel is used for reinforcing; manner in which work was carried out.

DISINTEGRATION. Can Concrete Resist Seawater? L. H. Csanyi. *Mun. Engrs. J.*, vol. 28, Third quarterly issue, 1942, pp. 76–92, (discussion) 96–98, 4 charts. Report of investigation conducted prior to construction of East River Drive, including survey of available literature, examination of numerous concrete structures in harbor of New York, together with compilation of all relevant data, such as design of mix, structural design, methods of construction and protection; study of mixes in East River Drive to determine their resistance to magnesium sulfate solution and some of their characteristics below low water.

DISINTEGRATION. Deterioration of Concrete in Normal Service, R. Allin. *Civ. Eng.* (London), vol. 37, no. 438, Dec. 1942, pp. 251–253. Study concerns hydraulic structures and concrete masses in general, under continual exposure to water pressure and tidal action; reasons for concrete disintegration discussed; effect of temperature on disintegration; laboratory experiments ..ar have shown no conclusive evidence that water-proofing produces greater durability. Bibliography.

MIXING. Concrete Mixture Design, A. T. Goldbeck. *Crushed Stone J.*, vol. 17, no. 5, Nov.-Dec. 1942, pp. 3–10. Discussion which presents facts justifying use of method for designing workable concrete for any desired compressive strength, using any type of coarse aggregate; method originally described in article indexed in *Engineering Index 1942* from issue of May-June 1942.

REINFORCEMENT. Saving Reinforcing Steel by Balancing Design, A. J. Boase. *Western Soc. Engrs.—J.*, vol. 47, no. 5, Oct. 1942, pp. 195–202. Discussion of factors of proposed WPB recommendation, which states that reinforced concrete members shall be designed for total load of three-quarters of dead load plus live load, using allowable stresses set forth in governing code; factor of safety and proposed basis of design considered.

SAFE HANDLING. Safer Handling of Concrete, L. C. Hammond. *Better Roads*, vol. 13, no. 1, Jan. 1943, p. 36. Nail punctures and cement burns are most common accidents in placing concrete; safety programs will save men and money. Abstract of paper before 1942 Nat. Safety Congress.

TANKS. Navy Builds Prestressed Concrete Tanks, R. B. Garrabrant. *Eng. News-Rec.*, vol. 130, no. 4, Jan. 28, 1943, pp. 135–137. To store its fuel supplies without using critical steel plates, the Navy is making extensive use of concrete tanks and is using prestressed design to minimize shrinkage cracks; all tanks are buried underground; iron dust mortar is used in annular joint between wall and floor to save rubber ordinarily required; roofs are supported by columns; various types of linings have been developed to eliminate reactions between fuel and concrete.

CONSTRUCTION INDUSTRY

POST-WAR. Civil Engineers and Building Industry. *Engineer*, vol. 174, no. 4,531, Nov. 13, 1942, pp. 398–399. Report of third of discussion meetings at Institution of Civil Engineers, arising out of Conference on "Civil Engineers and Building Industry"; subject for consideration was contribution of science and research to building industry.

POST WAR. How British Have Organized Their Study of Post-War Building. *Architect & Engr.*, vol. 151, no. 3, Dec. 1942, pp. 22–23. Organization chart of British study committees carrying on research and development in building field; list of committees of American Standards Assn. which are working on comparable building problems.

PUBLIC WORKS, POST-WAR. Public Building to Come, R. Moses. *Am. City*, vol. 58, no. 3, Mar. 1943, pp. 35–36 and 44. Post-war construction problems need wartime foresight and courage; task for industry, labor, and government; contract jobs vs. work relief; proposed Boston-Washington express highway; unavoidable public responsibility. Before Conference of Highway Officials of North Atlantic States.